Long Lake
Aquatic Vegetation Management Plan
2007-2011
Porter County, Indiana

February 20, 2008

Prepared for:
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Executive Summary

Aquatic Control was contracted by the Valparaiso Lakes Area Conservancy District (VLACD) to complete aquatic vegetation sampling in order to create a lakewide, long-term integrated aquatic vegetation management plan for Long Lake. Long Lake is located just north of Valparaiso in Porter County, Indiana. This plan was created in order to more effectively document and control nuisance aquatic vegetation within the lake. This plan was also created as a prerequisite to eligibility for LARE program funding to control nuisance exotic vegetation.

Aquatic vegetation is an important component of Indiana Lakes. Aquatic vegetation provides fish habitat, food for wildlife, prevents erosion, and can improve overall water quality. However, as a result of many factors, this vegetation can develop to a nuisance level. Nuisance aquatic vegetation, as used in this paper, describes plant growth that negatively impacts the present uses of the lake including fishing, boating, swimming, aesthetic, and lakefront property values. The primary nuisance species within Long Lake is the invasive exotic plant Eurasian watermilfoil (*Myriophyllum spicatum*). The negative impact of this species on native aquatic vegetation, fish populations, water quality, and other factors is well documented and will be discussed in further detail. The invasive exotic species curlyleaf pondweed (*Potamogeton crispus*) is also present.

The VLACD received a $7,200 grant from LARE in order to create a lake vegetation management plan. VLACD selected Aquatic Control Inc. to complete sampling and complete the plan. On May 15, 2007, a spring Invasive Species Mapping and a Tier II survey were completed by Aquatic Control to locate and record beds of invasive plants and document native species abundance. Less than one acre of Eurasian watermilfoil (0.58 acres) and just over one acre of curlyleaf pondweed (1.25 acres) was found within Long Lake.

On August 8, 2007, a Tier II survey was conducted. The purpose of this survey was to document the native plant community and map possible areas for treatment of invasive species in 2008. The most abundant species collected was common coontail (*Ceratophyllum demersum*). Eurasian watermilfoil had increased from the spring survey and was now found at 20% of the sites sampled.

A public meeting was held on October 17, 2007 in order to inform lake users of the plant management activities and gain their input on the direction of the plan. The primary concern that came out of the meeting was a need to address the problems caused by the amount of vegetation within the lake. Another meeting was conducted with LARE biologists, District Fisheries Biologist and representatives from VLAC on November 9. Sampling and treatment data along with a potential budget and action plan was presented and discussed at this meeting. Following these meetings three goals for vegetation management were created:

1. Maintain a stable, diverse aquatic plant community that supports a good balance of predator and prey fish and wildlife species, good water quality, and is resistant to minor habitat disturbances and invasive species
2. Direct efforts to preventing and/or controlling the negative impacts of aquatic invasive species.
3. Provide reasonable public recreational access while minimizing the negative impacts on plant and fish and wildlife resources.

In order to meet the goals several actions will need to be initiated. The primary recommendation for plant control within Long Lake involves the use of Renovate herbicide (active ingredient triclopyr) to selectively control Eurasian watermilfoil throughout the lake. Approximately 11 acres of Eurasian watermilfoil may need to be treated in the spring of 2008. This type of treatment should preserve and enhance the population of native vegetation and relieve nuisance conditions created by Eurasian watermilfoil. The control of Eurasian watermilfoil in Long Lake is especially important. Long Lake flows into Flint Lake, which has just completed its first year of LARE funded management for the same exotic species. Treatments on Flint Lake reduced Euraisan watermilfoil to a non-detectable level by the summer of 2007. If exotic species in Long Lake are not managed, continual introduction into Flint Lake is a possibility.

Currently, there is an abundant and diverse native plant population present in Long Lake. This vegetation is very beneficial to the overall health of the Long Lake ecosystem. Vegetation controls should be primarily focused on the use of highly selective controls in order to reduce damage to the native population. However, some small-scale control of native vegetation may be needed in high use areas in order to reduce potential nuisance conditions that may arise after Eurasian watermilfoil is controlled.

The following is a list of actions designed to control nuisance exotic species while preserving the native species diversity that exists in Long Lake.

1. Treat Eurasian watermilfoil wherever it is detected with Renovate 3 aquatic herbicide in an effort to reduce Eurasian watermilfoil to less than 5% of the littoral zone surface area. Ideally, Eurasian watermilfoil would be eliminated from the lake, but this may be difficult due to its presence in other lakes connected to or near Long Lake.
2. Complete a pretreatment invasive species mapping survey prior to any vegetation management in early spring 2008 and continue these surveys through 2011 in order to assess the success of controls.
3. Complete Tier II surveys in mid to late summer in order to document changes in the native community.
4. Continue to assess, adjust, and update the Long Lake Management Plan through 2011.

Acknowledgements

Funding for the vegetation sampling and preparation of an aquatic vegetation management plan was provided by the Valparaiso Lakes Area Conservancy District and the Indiana Department of Natural Resources Lake and River Enhancement Program. Aquatic Control, Inc. completed the fieldwork, data processing, and map generation. Special thanks are due to Bob Minarich and the Valparaiso Lakes Area Conservancy District for their help in initiating and completing this project. Special thanks are given to Bob Robertson, Fisheries Biologists for the Indiana Department of Natural Resources-Division of Fish and Wildlife, for their assistance and review of this plan. Special thanks are also given to Gwen White and Angela Studevant, Aquatic Biologist from the Lake and River Enhancement Program (LARE) for their review and assistance on this plan. Author of this report is Brendan Hastie of Aquatic Control. The author would like to acknowledge the valuable input from Brian Isaacs, Nathan Long, Joey Leach, and Barbie Huber of Aquatic Control for their field assistance, map generation, review, and editing of this report.

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1.0 INTRODUCTION

Aquatic Control was contracted by the Valparaiso Lakes Area Conservancy District (VLACD) to complete aquatic vegetation sampling in order to create a lakewide, long-term integrated aquatic vegetation management plan. The study area includes Long Lake, which is located within a chain of lakes called the Valparaiso Lakes just north of Valparaiso in Porter County, Indiana. This plan was created in order to more accurately document the aquatic vegetation community and create a feasible plan for managing nuisance vegetation within Long Lake. The plan is also a prerequisite to eligibility for the Lake and River Enhancement (LARE) program funding to control exotic or nuisance species. Three vegetation surveys were completed in 2007 in order to document the plant community. The surveys will provide valuable information that will allow for scientifically based recommendations for aquatic plant management. The focus of aquatic plant management will be on the control of exotic invasive species. However, some native vegetation in high-use areas may require some form of control.

The primary nuisance aquatic submersed plant species in Long Lake is the exotic species Eurasian watermilfoil. The invasive exotic species curlyleaf pondweed was also found during the spring surveys. The presence of the exotic emergent, purple loosestrife (*Lythrum salicaria*), was noted in previous surveys and was noticed during the 2007 aquatic plant sampling. It is important to initiate management of these species in order to reduce nuisance conditions and stop their spread to Flint Lake. In order to successfully manage aquatic vegetation on a public body of water concerns of fishermen, lot owners, biologists, and the general public will have to be addressed. The purpose of this plan is to provide plant management recommendations that will balance the concerns of these interest groups while effectively relieving Long Lake of nuisance aquatic plant growth while working towards the goals of the plant management program.

2.0 WATERSHED AND WATERBODY CHARACTERISTICS (Summarized from JFNew 2003)

Long Lake is the second largest lake within a chain of natural lakes that includes Canada, Deep, Flint, Loomis, Mink, Moss, Silver, Spectacle, and Wauhob Lakes. The lakes are located just north of Valparaiso in Porter County, Indiana. In combination, these lakes have a surface area of 339.5 acres and a 2,560-acre watershed. Long Lake is approximately 65 acres with a maximum depth of 26 feet, average depth of approximately 8 feet, and a shoreline length of 9,615 feet (Figure 1). Long Lake's direct watershed encompasses 411.7 acres. Residential areas occupy 169.8 acres of the watershed. Approximately 70% of the residential areas are high-density areas. Emergent wetlands, emergent shrub wetlands, and forested land compose 137.2 acres of Long Lake's watershed. (JFNew 2003). Long Lake has extensive shallow areas with 63% of the lake area less than ten feet deep. The majority of Long Lake's water volume resides in the shallower depths. The relative abundance of shallower waters in Long Lake increases the area where rooted vegetation may grow.

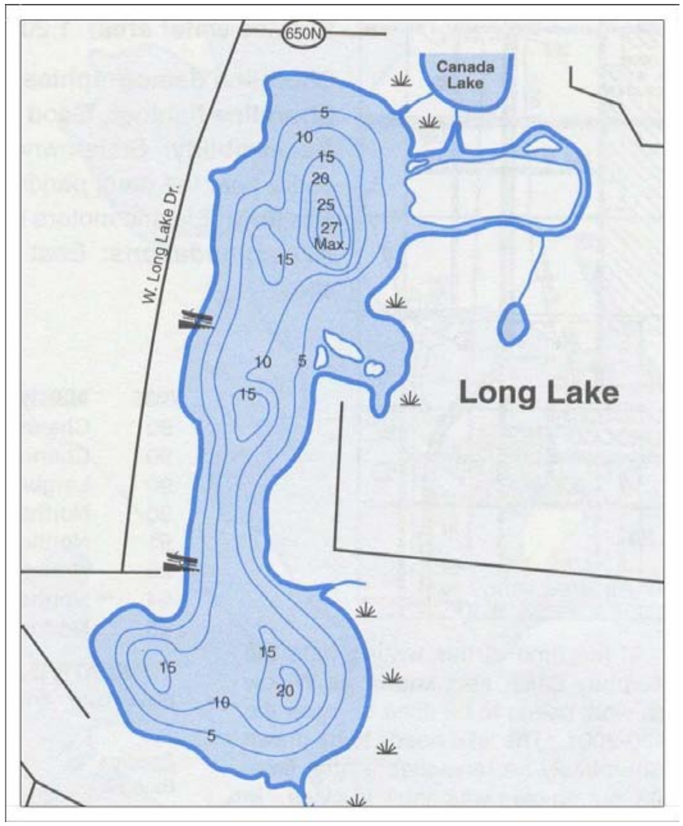

Figure 1. Long Lake Bathymetric Map (Sportsman's Connection, 2002)

Long Lake's clarity appears to be good when compared to other lakes in the chain. When comparing historical Secchi readings to ones taken this season, there appears to be an overall improvement in clarity. A much more detailed watershed and waterbody characteristics discussion can be found in the 2003 Valparaiso Lakes Diagnostic Study which was funded by the VLACD and LARE.

The VLACD has been very proactive about educating the public. The board of the VLACD has asked residents to correct erosion problems, and when ignored, has sought legal means to rectify the actions of irresponsible lot owners. The group has also been very aggressive with replacing the septic systems in the area with sewage service. The VLACD plans on adding an additional 16 lots to the sewage system on Long Lake later this year. This board has been very active within the watershed as a whole. They have been promoting dialog between local government and commercial builders to ensure that best management practices are followed to protect their natural resources.

3.0 PRESENT WATER BODY USES

The Valparaiso Chain of Lakes has been a resort site for Porter County residents for over a hundred years (VLACD website). Today, Long Lake is used for a variety of activities. An access site is located along the southwestern shore. Virtually the entire western shoreline of Long Lake is residentially developed. The majority of the eastern shore is undeveloped and is shrub wetland area (Figure 2). Fishing, boating, and swimming are popular activities on Long Lake. High speed boating is not permitted on the lake. At a recent public meeting, lake users indicated that 60% used the lake for boating and fishing, and 40% used the lake for swimming (survey included 5 individuals).

Figure 2. Long Lake Usage Map

4.0 FISHERIES (Summarized from JFNew 2003)

IDNR has conducted several fisheries studies over the past 38 years to assess the Valparaiso Chain of Lakes. Surveys were conducted on Long Lake in 1965, 1972, 1986, and 2001. In general, yellow perch and largemouth bass populations increased from 1965 to 2001 while black crappie, redear sunfish, and bluegill populations decreased. The overall relative abundance of bluegill decreased by nearly 9% over the thirty-five year period between surveys and the relative abundance of harvestable bluegill more than doubled. Through competition for food and habitat, the bluegill population may play a role in limiting the population growth of black crappie and redear sunfish. The relative abundance of largemouth bass collected increased substantially from 1965 to 2001. The majority of the bass collected throughout the years were only average in size (8-14 inches).

4.1 Aquatic Vegetation and Fish Management

Aquatic vegetation is an important component in fisheries management. Aquatic vegetation provides cover for adult and juvenile fish, supports aquatic invertebrates that are eaten by fish, and shelters small fish from predators. However, dense vegetation, especially Eurasian watermilfoil, can have negative effects of fish growth. Dr. Mike Maceina of Auburn University found that dense stands of Eurasian watermilfoil on Lake Guntersville proved to be detrimental to bass reproduction due to the survival of too many small bass. This led to below normal growth rates for largemouth bass and lower survival to age 1. Maceina found higher age 1 bass density in areas that contained no plants verses dense Eurasian watermilfoil stands (Maceina 2001). Bluegill growth rates can also be affected by dense stands of Eurasian watermilfoil. It is well known by fisheries biologists that overabundant dense plant cover gives bluegill an increased ability to avoid predation and increases the survival of small young fish, which can lead to stunted growth.

5.0 PROBLEM STATEMENT

As previously mentioned, aquatic vegetation is an important component of lakes in Indiana. However, as a result of many factors, this vegetation can develop to nuisance levels. Nuisance aquatic vegetation, as used in this paper, describes plant growth that negatively impacts the present uses of the lake including fishing, boating, swimming, aesthetic, and lakefront property values. The primary nuisance species within Long Lake is the exotic species Eurasian watermilfoil. Curlyleaf pondweed is another submersed exotic species that is present in Long Lake and has the potential to create nuisance conditions. The presence of submersed aquatic nuisance plants in Long Lake is of particular concern. Long Lake flows into Flint Lake, thus facilitating the spread and re-infestation of problematic vegetation from lake to lake. Purple loosestrife is an invasive exotic emergent species that was also detected in previous sampling. This species will not likely create nuisance conditions for lake users, but could have negative impacts on native wetland species in and around Long Lake.

5.1 Problems Caused By Eurasian Watermilfoil

Eurasian watermilfoil is an exotic invasive species of submersed vegetation that was likely introduced into our region prior to the 1940's (Figure 3). This species commonly reaches nuisance levels in Indiana Lakes. Once established, growth and physiological characteristics of milfoil enable it to form a surface canopy and develop into immense stands of weedy vegetation, outcompeting most submersed species and displacing the native plant community. These surface mats can severely impair many of the functional aspects of waterbodies such as maintenance of water quality for wildlife habitat and public health, navigation, and recreation. Furthermore, a milfoil-dominated community can greatly reduce the biodiversity of an aquatic system and negatively impact fish populations (Getsinger et. al., 1997).

Figure 3. Illustration of Eurasian watermilfoil (Illustration provided by Applied Biochemist).

5.2 Problems Caused by Curlyleaf Pondweed

Curlyleaf pondweed is an invasive exotic submersed species that was likely introduced in the early 1900's. It is present in many Indiana natural lakes and manmade impoundments. Curlyleaf pondweed's wavy serrated leaves give it a rather unique appearance (Figure 4). Richardon's pondweed (*Potamogeton richarsonii*) is probably the only species with which it is easily confused. Curlyleaf pondweed has the tendency to create dense surface mats in the spring and early summer. These mats can interfere with recreation and limit the growth of native species. Another problem associated with this species is caused by its summer die-off that tends to lead to algae blooms. The summer die-off also tends to lessen the impact of this species on lake recreation.

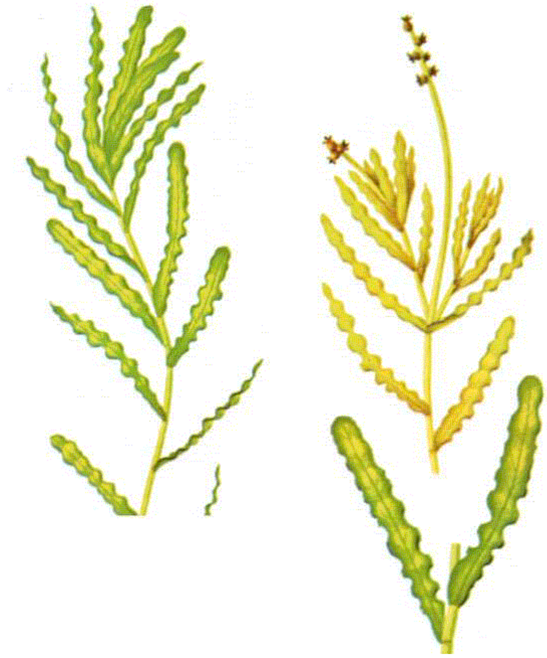

Figure 4. Illustration of curlyleaf pondweed (Illustration provided by Applied Biochemist).

5.3 Problems Caused by Purple Loosestrife

Purple loosestrife is an exotic invasive species of emergent vegetation that has invaded many wetlands and lake margins throughout Indiana (Figure 5). This species was introduced from Eurasia and became established in the estuaries of northeastern North America by the early 1800's. The impact of purple loosestrife on native vegetation has been disastrous, with more than 50% of the biomass of some wetland communities displaced. Impacts on wildlife have not been well studied, but indicate serious reduction in waterfowl and aquatic furbearer productivity (Thompson et. al. 1987).

Figure 5. Illustration of Purple Loosestrife (Illustration provided by Applied Biochemist).

6.0 VEGETATION MANAGEMENT GOALS

An effective aquatic vegetation management plan must include well-defined goals and objectives. Listed below are three goals formulated by LARE program staff and Division of Fish and Wildlife Biologists and approved by the Valparaiso Lakes Area Conservancy District. The objectives and actions used to meet the objectives will be discussed in section 12.0. One must have a better understanding of the plant community before the objectives and actions can be discussed.

Vegetation Management Goals

1. Maintain a stable, diverse aquatic plant community that supports a good balance of predator and prey fish and wildlife species, good water quality, and is resistant to minor habitat disturbances and invasive species
2. Direct efforts to preventing and/or controlling the negative impacts of aquatic invasive species.
3. Provide reasonable public recreational access while minimizing the negative impacts on plant and fish and wildlife resources.

7.0 PLANT MANAGEMENT HISTORY

There is no record of past vegetation management completed on Long Lake. Aquatic Control has talked to several of the homeowners on the lake and has learned that several have done limited shoreline treatments in front of their homes and around their docks.

8.0 AQUATIC PLANT COMMUNITY CHARACTERIZATION

Aquatic vegetation sampling must be completed in order to create an effective aquatic vegetation management plan. Sampling provides valuable data that allows managers to accomplish several tasks: locate areas of nuisance and beneficial vegetation; monitor changes in density, abundance, and location of native and exotic species; monitor and react to changes in the overall plant community; monitor the effectiveness of management techniques; and compare the Long Lake plant community to other populations. Prior to 2007, aquatic vegetation had been sampled on Long Lake by several different groups with several different techniques.

Faculty and students of Purdue University North Central have conducted several studies of the plant community within the Valparaiso Chain of Lakes. They found that species diversity varied from lake to lake, but most lakes in the chain possessed between 30-40 different species. Flint Lake and Spectacle Lake had the greatest diversity with 41-43 species present in those lakes respectively (Unpublished data presented at the March 7, 2001 VLACD meeting and cited in JFNew, 2003).

The IDNR fish surveys provide historical information about the submersed aquatic vegetation in Long Lake. Fisheries reports from the 1960's through the 1980's described Long Lake as "weedy". The fisheries reports as well as the most recent survey (2001) completed by JFnew indicated that rooted plants can grow in water up to 15 feet (4.7 m) in depth in Long Lake. Long Lake's excellent water clarity likely enables this growth. In contrast to the earlier fisheries surveys, the 2001 Long Lake fishery survey describes the lake's aquatic plant community as "extremely diverse".

JFNew completed plant surveys on Long Lake in 2001. They concluded that the plant community in Long Lake exhibited great diversity in comparison to the other bodies of water within the chain of lakes. JFNew noted that rooted aquatic plants were growing in water depths up to 15 feet. Some of the aquatic plants collected in Long Lake during the 2001 survey, such as white stem pondweed, indicated that Long Lake had good water quality. The 2001 survey also revealed that Long Lake and its adjacent wetland had the largest population of purple loostrife within the chain of lakes. Curlyleaf pondweed was also collected during the survey. JFNew recommended the control of exotic nuisance species to help preserve the plant diversity on Long Lake (JFNew 2003).

Aquatic Control conducted two different types of aquatic vegetation surveys during the 2007 growing season. These surveys were completed according to the LARE surveying protocol that is described below. The spring invasive survey was completed May 15, 2007. The Tier II surveys were conducted on May 15, 2007 and August 8, 2007 but are not a complete inventory of all plants present within Long Lake. The surveys are designed to detect areas of exotic plant growth as well as document areas of important native species. Table 1 shows all the aquatic species of plants detected during the surveys conducted in 2007.

Table 1. Scientific and Common Names of Species Sampled in 2007 from Long Lake.

Scientific Name	Common Name
Brasenia schreberi	watershield
Cephalanthus occidentalis	button bush
Ceratophyllum demersum	common coontail
Decodon verticillatus	swamp loosestrife
Elodea canadensis	American elodea
Hibiscus palustris	swamp rose mallow
Lythrum salicaria	purple loosesrtife
Myriophyllum sibiricum	northern watermilfoil
Myriophyllum spicatum	Eurasian watermilfoil
Nuphar variegetum	spatterdock
Nymphaea tuberosa	white water lily
Peltandra virginica	arrow arum
Polygonum hydropiper	water smartweed
Pontederia cordata	pickerel weed
Potamogeton crispus	curlyleaf pondweed
Potamogeton gramineus	variable pondweed
Potamogeton richardsonii	Richardson's pondweed
Potamogeton zosteriformis	flatstemmed pondweed
Utricularia vulgaris	common bladderwort
Vallisneria americana	eel grass

8.1 Methods

8.1.1 Spring Invasive Species Mapping

The spring invasive species survey is a reconnaissance survey used to map the acreage and distribution of invasive species of plants. The survey is done while driving across the littoral zone in a zigzag fashion until beds of non-native invasive species are found. A sample rake attached to a length of rope is used for bottom sampling in areas of low visibility to confirm species presence. The perimeter of the plant bed is then recorded into a handheld GPS unit and notes are taken marking the waypoints, species present and relative abundance. The advantage to using this form of survey is that fairly accurate invasive species distribution maps can be generated with relatively low amounts of labor. The maps generated from this survey make the treatment of invasive species much more accurate and effective.

8.1.2 Tier II Methods

The Tier II survey helps meet the following objectives:

1. to document the distribution and abundance of submersed and floating-leaved aquatic vegetation
2. to compare present distribution and abundance with past distribution and abundance within select areas

The number and depth of sampling sites are selected based upon lake size and classification. Once a site was reached the boat was slowed to a stop and the coordinates were recorded on a hand-held GPS unit and later downloaded into a mapping program. A depth measurement was taken by dropping a two-headed standard sampling rake that was attached to a rope marked off in 1-foot increments (Figure 6). An additional ten feet of rope was released and the boat was reversed at minimum operating speed for a distance of ten feet. Once the rake is retrieved the overall plant abundance on the rake is scored with either a 0 (no plants retrieved), 1 (1-20% of rake teeth filled), 3 (21-99% of rake teeth filled), or 5 (100% of rake teeth filled) and then individual species are placed back on the rake and scored separately.

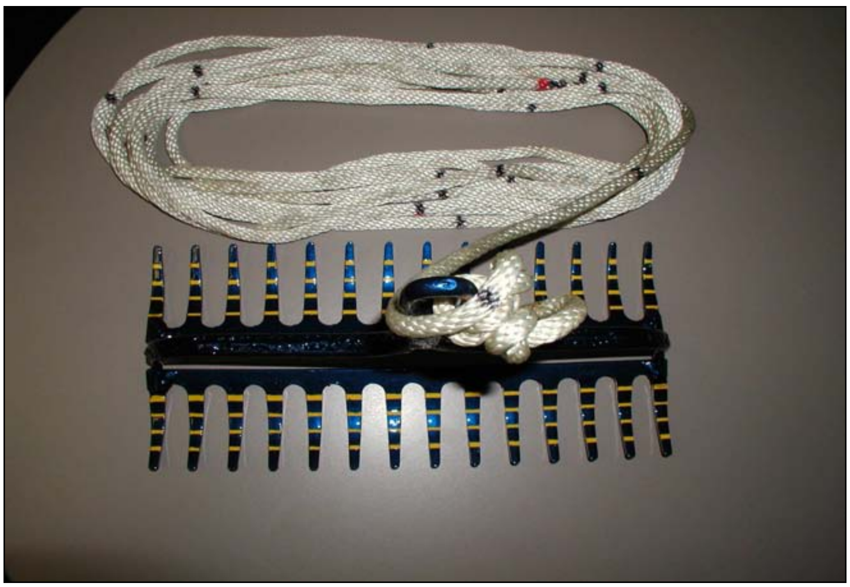

Figure 6. Sampling Rake

The data is used to calculate different lake characteristics and community and species metrics. The different characteristics and metrics calculated from the Tier II method are defined below:

<u>Littoral depth</u>: Maximum depth that aquatic vegetation is present.
<u>Total sites</u>: Total number of sites sampled.
<u>Secchi depth</u>: Measurement of the transparency of water.
<u>Species richness</u>: count of all submersed plant species collected.
<u>Native species richness</u>: count of all native submersed plant species collected.
<u>Maximum number of species per site</u>: highest number of species collected at any

site.
Mean number of species per site: The average number of all species collected per site.
Mean number of native species per site: The average number of native species per site.
Species diversity index: This is a modified Simpson's diversity index which is a measure that provides a means of comparing plant community structure and stability over time.
Frequency of occurrence: Measurement of the proportion of sites where each species is present.
Relative frequency of occurrence: Measures how the plants occur throughout the lake in relation to each other.
Dominance index: Combines the frequency of occurrence and relative density into a dominance value that characterizes how dominant a species is within the macrophyte community (IDNR, 2006).

8.2 Results

8.2.1 2007 Spring Survey

On May 15, 2007, Aquatic Control completed a spring invasive species mapping survey and a Tier II survey on Long Lake. A Secchi measurement was taken and found to be 11.0 feet. Plants were found to be growing to a maximum depth of 17 feet.

Spring Invasive Mapping Survey (Long Lake)
The spring invasive mapping survey was completed on May 15, 2007. The survey revealed Eurasian watermilfoil and curlyleaf pondweed were growing in Long Lake. Less than 1 acre of Eurasian watermilfoil (0.58 acres) and 1.25 acres of curlyleaf pondweed were found during the spring survey (Figures 7 & 8).

Figure 7. Eurasian watermilfoil beds May 15, 2007

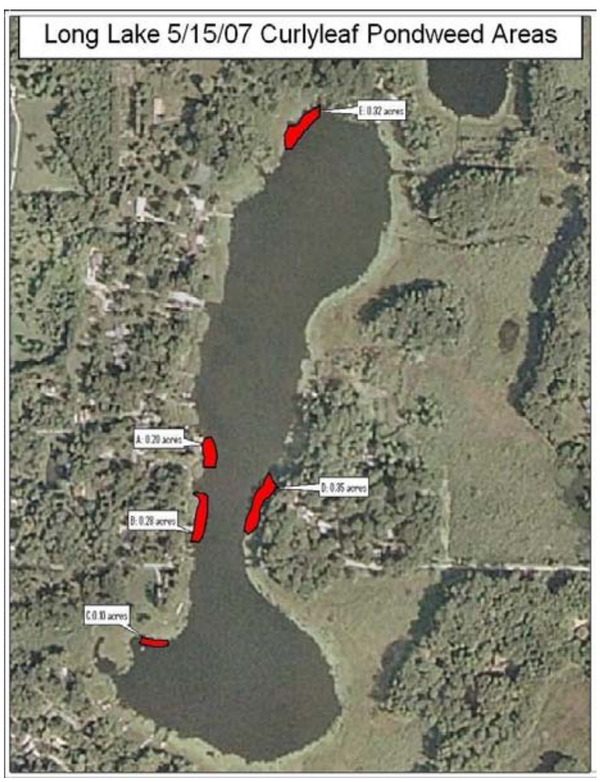

Figure 8. Curlyleaf pondweed beds May 15, 2007

Spring Tier II Survey

A Tier II survey was completed on May 15, 2007. The number and depth of sites was determined prior to sampling based upon lake size and trophic status according to IDNR protocol. Forty sites were selected within the littoral zone for the survey. Ten sites were sampled from 0-5 feet, 5-10 feet, 10-15, and 15-20 feet. Of the 40 sites sampled, 29 had submerged plants all containing native species. Nine species of aquatic plants were collected during the sampling. One exotic species, curlyleaf pondweed, was found. Results from the Tier II sampling are shown in Table 2. The maximum number of species collect from a site was 5. The mean species collected per site and the mean native species collected per site was 2.18.

Table 2. Occurrence and abundance of submersed aquatic plants in Long Lake, May 15, 2007

Occurrence and abundance of submersed aquatic plants in Long Lake

County:	Porter	Sites with plants:	29	Mean species/site:	2.18
Date:	5/15/2007	Sites with native plants:	29	Standard error (ms/s):	0.2652708
Secchi (ft):	11	Number of species:	8	Mean native species/site:	2.18
Maximum plant depth (ft):	17	Number of native species:	7	Standard error (mns/s):	0.2652708
Trophic status	Mesotrophic	Maximum species/site:	5	Species diversity:	0.78
Total sites:	40			Native species diversity:	0.75

All depths (0 to 20 ft)	**Frequency of**	**Rake score frequency per species**				**Plant Dominance**
Species	**Occurrence**	**0**	**1**	**3**	**5**	
common coontail	67.5	32.5	17.5	12.5	37.5	42.5
flatstemmed pondweed	55.0	45.0	17.5	7.5	30.0	11.0
common bladderwort	47.5	52.5	12.5	10.0	25.0	19.5
northern watermilfoil	20.0	80.0	2.5	10.0	7.5	4.0
curlyleaf pondweed	12.5	87.5	2.5	2.5	7.5	3.5
eel grass	5.0	95.0	0.0	0.0	5.0	1.0
American elodea	5.0	95.0	0.0	0.0	5.0	1.0
Richardson's pondweed	5.0	95.0	2.5	0.0	2.5	1.0

Depth: 0 to 5 ft	**Frequency of**	**Rake score frequency per species**				**Plant Dominance**
Species	**Occurrence**	**0**	**1**	**3**	**5**	
common coontail	100.0	0.0	40.0	10.0	50.0	56.0
common bladderwort	90.0	10.0	40.0	10.0	40.0	34.0
flatstemmed pondweed	70.0	30.0	20.0	10.0	40.0	14.0
northern milfoil	30.0	70.0	10.0	10.0	10.0	6.0
Richardson's pondweed	20.0	80.0	10.0	0.0	10.0	4.0
curlyleaf pondweed	10.0	90.0	0.0	0.0	10.0	2.0
eel grass	10.0	90.0	0.0	0.0	10.0	2.0
American elodea	10.0	90.0	0.0	0.0	10.0	2.0

Depth: 5 to 10 ft	**Frequency of**	**Rake score frequency per species**				**Plant Dominance**
Species	**Occurrence**	**0**	**1**	**3**	**5**	
common coontail	100.0	0.0	20.0	40.0	40.0	52.0
common bladderwort	80.0	20.0	10.0	30.0	40.0	40.0
flatstemmed pondweed	60.0	40.0	20.0	20.0	20.0	12.0
curlyleaf pondweed	20.0	80.0	0.0	10.0	0.0	4.0
northern milfoil	50.0	50.0	0.0	30.0	20.0	10.0
eel grass	10.0	90.0	0.0	0.0	10.0	2.0
American elodea	10.0	90.0	0.0	0.0	10.0	2.0

Depth: 10 to 15 ft	**Frequency of**	**Rake score frequency per species**				**Plant Dominance**
Species	**Occurrence**	**0**	**1**	**3**	**5**	
common coontail	60.0	40.0	10.0	0.0	50.0	52.0
flatstemmed pondweed	60.0	40.0	10.0	0.0	50.0	12.0
common bladderwort	20.0	80.0	0.0	0.0	20.0	4.0
curlyleaf pondweed	20.0	80.0	0.0	0.0	20.0	8

Depth: 15 to 20 ft	**Frequency of**	**Rake score frequency per species**				**Plant Dominance**
Species	**Occurrence**	**0**	**1**	**3**	**5**	
flatstemmed pondweed	30.0	70.0	20.0	0.0	10.0	6.0
common coontail	10.0	90.0	0.0	0.0	10.0	10.0

Other species observed: Eurasian watermilfoil, arrow arum, spatterdock, hibiscus, purple loostrife
pickeral weed, white water lily, watershield, buttonbush

Common coontail was the most frequently observed species during the spring Tier II survey and had the highest dominance rating. Coontail was found at 67.5% of all sites and 100.0% of the sites less than 10 feet deep. Dense beds of coontail were scattered throughout the lake. Figure 9 shows the distribution and abundance of coontail.

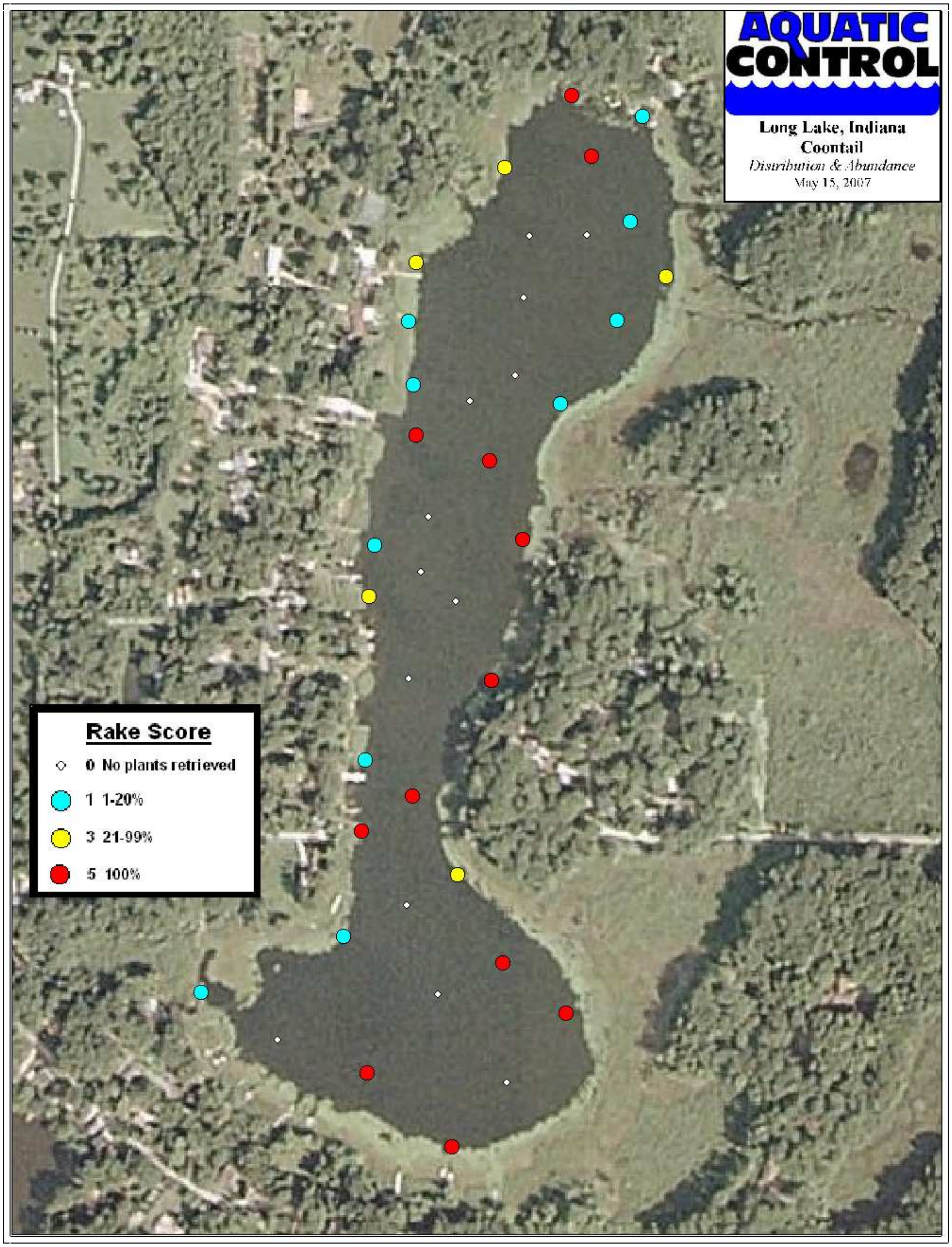

Figure 9. Long Lake, coontail distribution and abundance, May 15, 2007.

Flatstem pondweed was present at the second highest percentage of sample sites (55.0%). Flatstem pondweed was present at relatively low densities. Figure 10 illustrates the location and density of flatstem pondweed. Common bladderwort was third most abundant species followed by northern milfoil, curlyleaf pondweed, eel grass, American elodea.

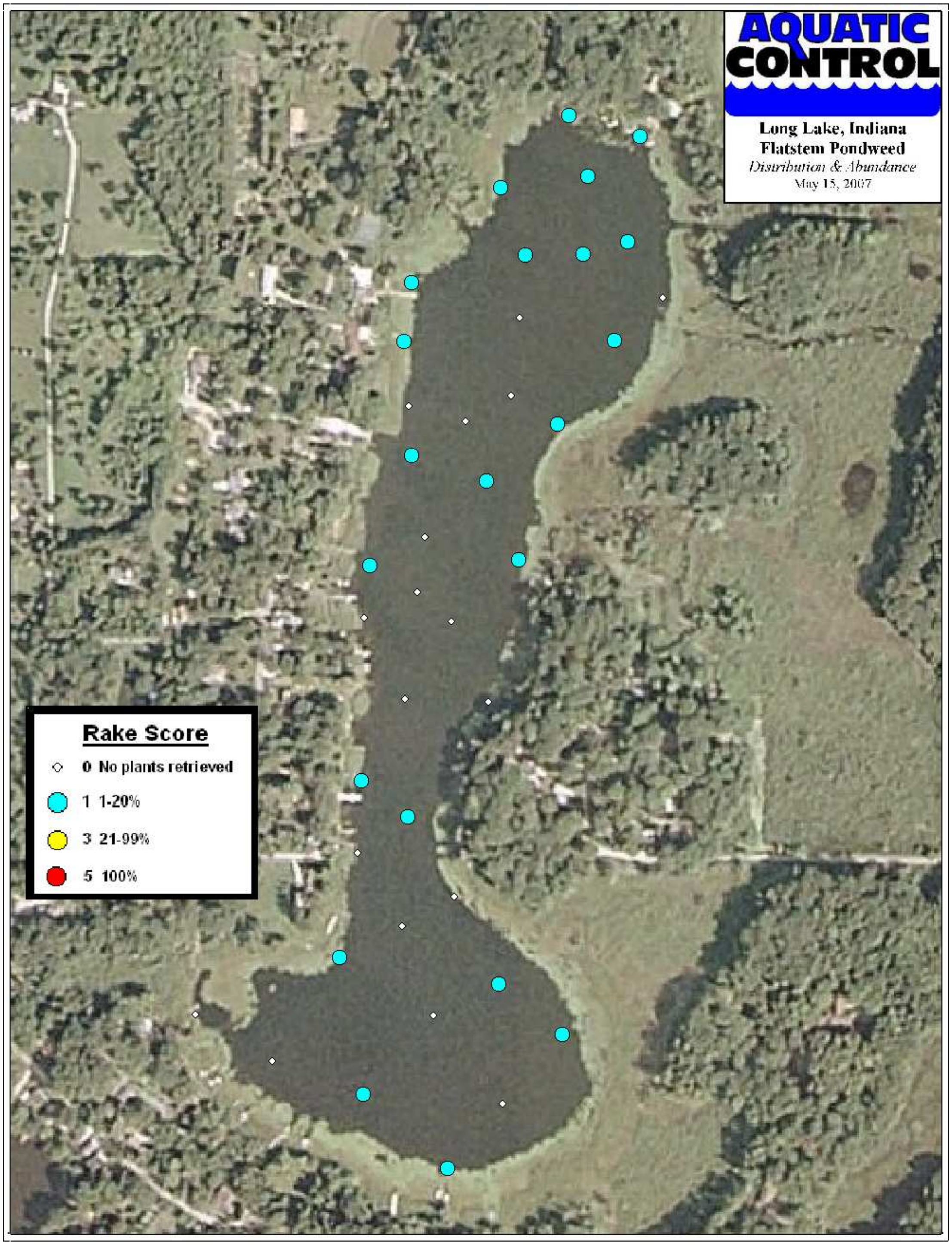

Figure 10. Long Lake, flatstem pondweed distribution and abundance, May 15, 2007.

Curlyleaf pondweed was the only exotic species collected during the spring Tier II survey. Curlyleaf pondweed was found at 12.5% of the sample sites (Figure 11). This plant was growing at a relatively low density where it was discovered and was not concentrated to just one area of Long Lake.

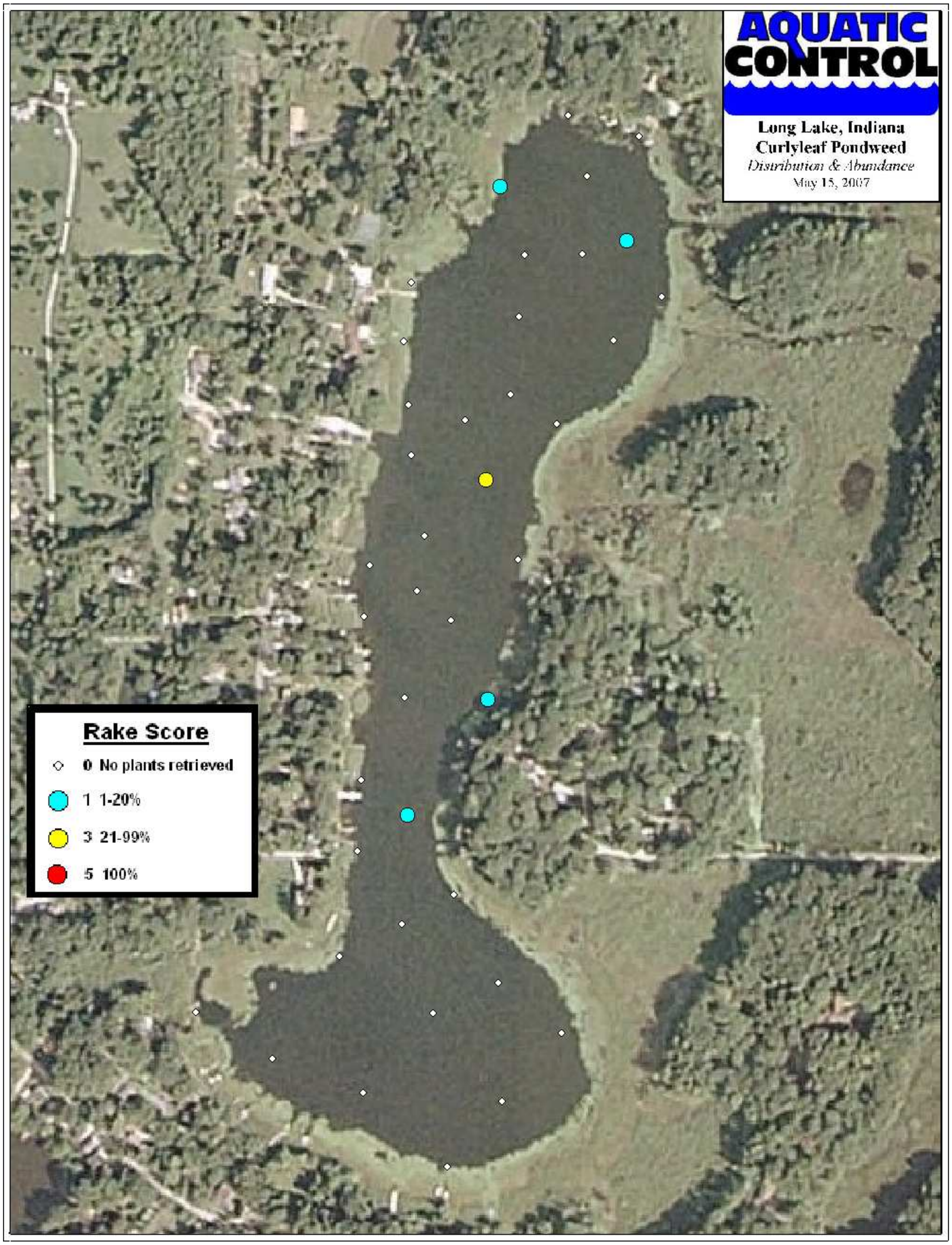

Figure 11. Long Lake, curlyleaf pondweed distribution and abundance, May 15, 2007

Richardson's pondweed was only found at two sites and was present at low densities (Figure 12). Richardson's pondweed is considered to be a species of concern in Indiana lakes.

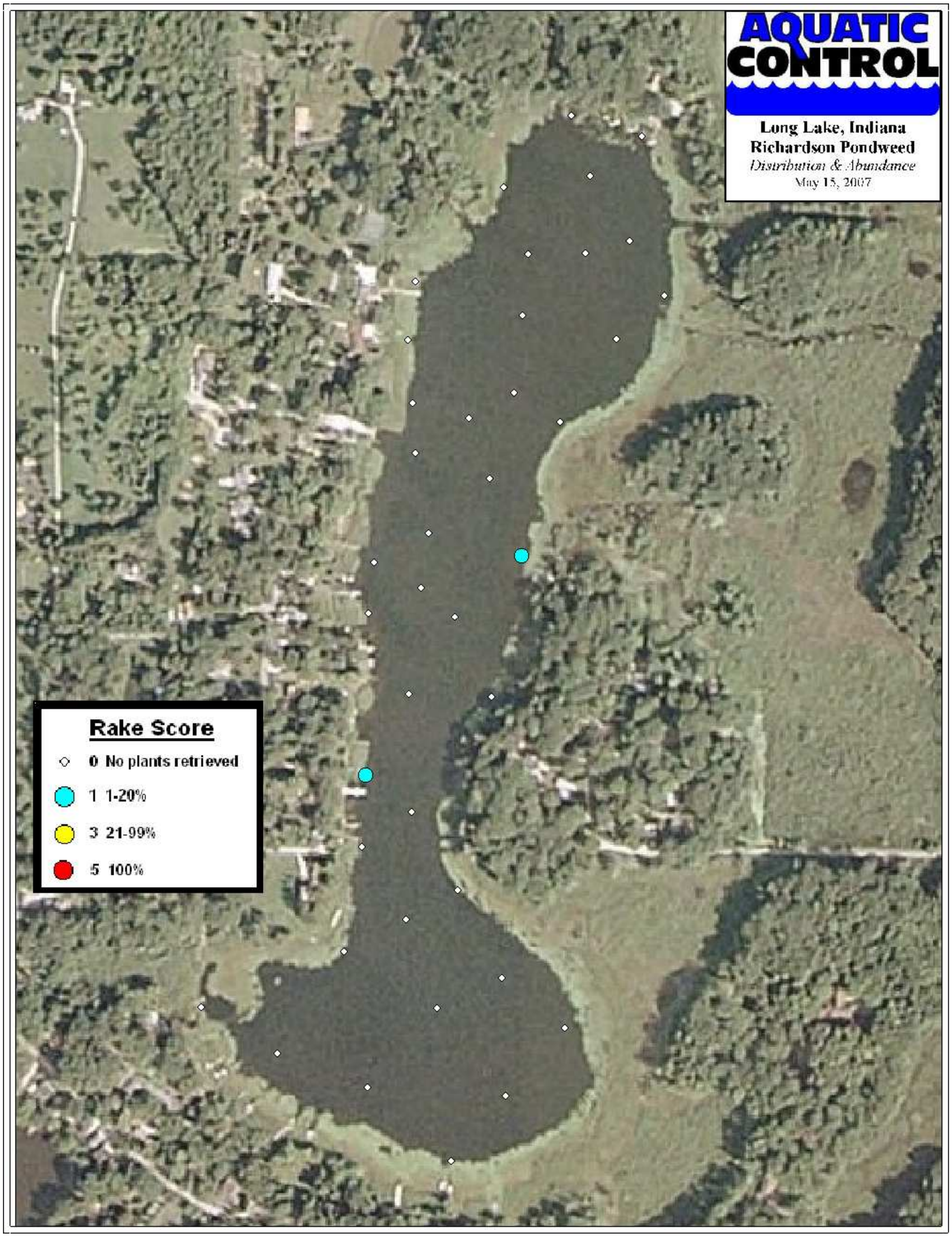

Figure 12. Long Lake, Richardson's pondweed distribution and abundance May 15, 2007

8.2.2 2007 Summer Survey

Summer Tier II survey

A second Tier II survey was completed on August 8, 2007 by Aquatic Control. A Secchi measurement was taken prior to the survey and found to be 9.5 feet. Vegetation was present to a maximum depth of 17.0 feet. The same sites that were used for the spring Tier II survey were sampled again in the summer Tier II survey. Of the 40 sites sampled, 28 had submersed aquatic vegetation. All 28 sites with plants contained native species. Eight species of submersed plants were collected during the summer survey. Eurasian watermilfoil was the only exotic species collected at that time. The maximum number of species collected at a site was 5 and the average number of species per site was 1.95. The average number of native species per site was 1.75. Table 3 displays the data obtained from the August Tier II survey.

Table 3. Occurrence and abundance of submersed aquatic plants in Long Lake, August 8, 2007

Occurrence and abundance of submersed aquatic plants in Long Lake					
County:	Porter	Sites with plants:	28	Mean species/site:	1.95
Date:	8/8/2007	Sites with native plants:	28	Standard error (ms/s):	0.2530582
Secchi (ft):	9.5	Number of species:	8	Mean native species/site:	1.75
Maximum plant depth (ft):	17	Number of native species:	7	Standard error (mns/s):	0.2199942
Trophic status	Mesotrophic	Maximum species/site:	5	Species diversity:	0.78
Total sites:	40			Native species diversity:	0.74

Depths: 0 to 17 ft	Frequency	Rake score frequency per species				Plant Dominance
Species	of Occurrence	0	1	3	5	
common coontail	65.0	35.0	5.0	2.5	57.5	56.0
flatstemmed pondweed	47.5	52.5	0.0	0.0	47.5	23.5
common bladderwort	32.5	67.5	0.0	0.0	32.5	16.5
Eurasian watermilfoil	20.0	80.0	0.0	2.5	17.5	11.0
eel grass	17.5	82.5	0.0	0.0	17.5	7.5
Richardson's pondweed	7.5	92.5	0.0	0.0	7.5	4.5
American elodea	2.5	97.5	0.0	0.0	2.5	0.5
variable pondweed	2.5	97.5	0.0	2.5	0.0	0.5

Depths: 0 to 5 ft	Frequency	Rake score frequency per species				Plant Dominance
Species	of Occurrence	0	1	3	5	
common coontail	87.5	12.5	0.0	12.5	75.0	72.5
Eurasian watermilfoil	87.5	12.5	0.0	12.5	75.0	52.5
common bladderwort	62.5	37.5	0.0	0.0	62.5	22.5
eel grass	50.0	50.0	0.0	0.0	50.0	20.0
flatstemmed pondweed	50.0	50.0	0.0	0.0	50.0	25.0
Richardson's pondweed	25.0	75.0	0.0	0.0	25.0	15.0
American elodea	12.5	87.5	0.0	0.0	12.5	2.5
variable pondweed	12.5	87.5	0.0	12.5	0.0	2.5

Depths: 5 to 10 ft	Frequency	Rake score frequency per species				Plant Dominance
Species	of Occurrence	0	1	3	5	
common coontail	100.0	0.0	0.0	0.0	100.0	96.4
flatstemmed pondweed	81.8	18.2	0.0	0.0	81.8	45.5
common bladderwort	72.7	27.3	0.0	0.0	72.7	43.6
eel grass	27.3	72.7	0.0	0.0	27.3	12.7
Eurasian watermilfoil	9.1	90.9	0.0	0.0	9.1	1.8
Richardson's pondweed	9.1	90.9	0.0	0.0	9.1	5.5

Depths: 10 to 15 ft	Frequency	Rake score frequency per species				Plant Dominance
Species	of Occurrence	0	1	3	5	
common coontail	53.8	46.2	7.7	0.0	46.2	44.6
flatstemmed pondweed	46.2	53.8	0.0	0.0	46.2	18.5

Depths: 15 to 17 ft	Frequency	Rake score frequency per species				Plant Dominance
Species	of Occurrence	0	1	3	5	
common coontail	12.5	87.5	12.5	0.0	0.0	2.5

Other species Observed: Smartweed, purple loosetrife, arrow arum, pickerel weed, white water lily, spatterdock, hibiscus, watershield, swamp loostrife, and button bush

Common coontail was the most frequently occurring and most dominant species in all depth ranges. Coontail did not seem to be concentrated to a particular section of the lake. Coontail was present in 65.0% of the sampling sites. Figure 13 shows the distribution and abundance of coontail in Long Lake in August.

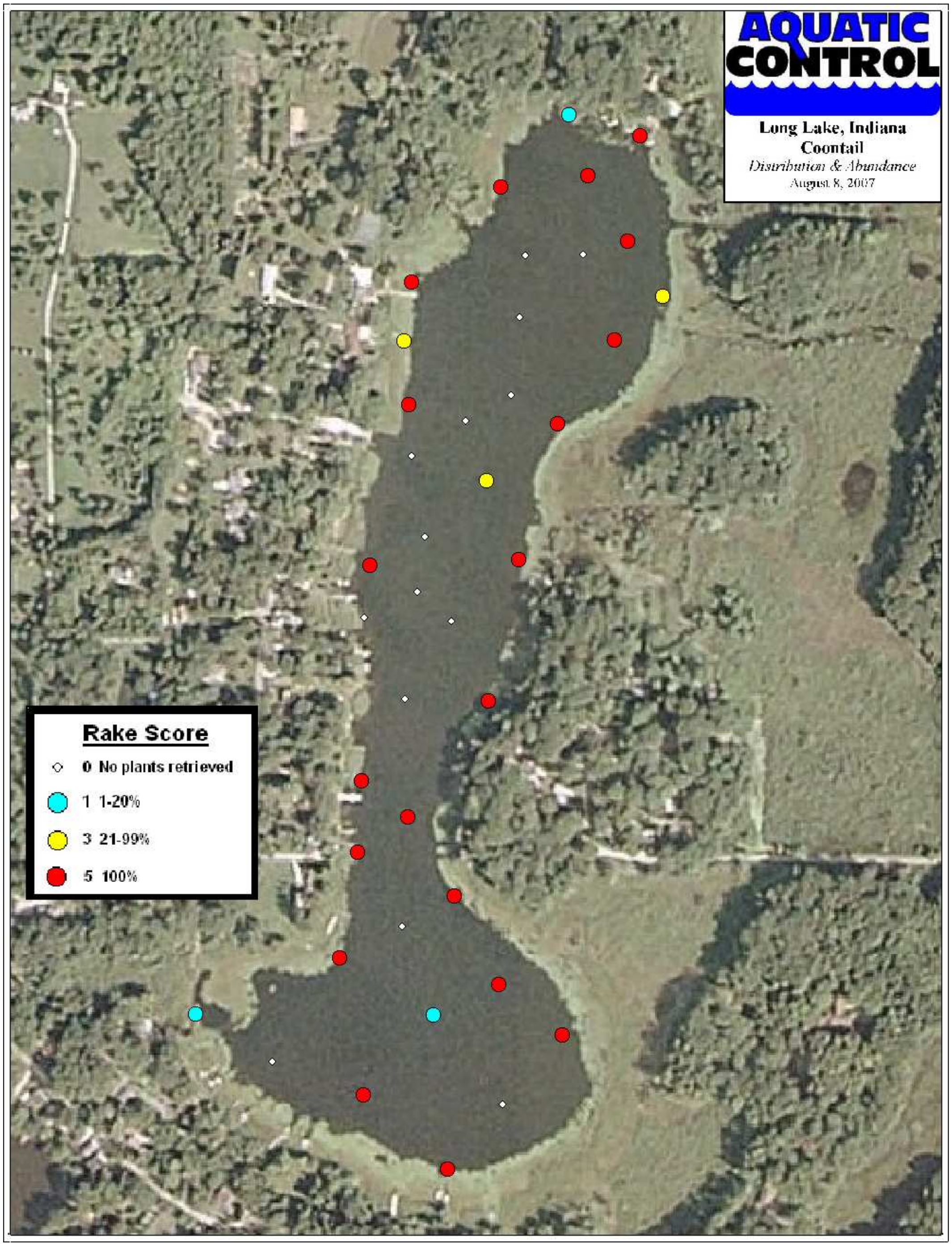

Figure 13. Long Lake, common coontail distribution and abundance, August 8, 2007.

Flatstem pondweed was the second most frequently occurring submersed aquatic plant (Figure 14). Flatstem pondweed was collected at 47.5% of all the sites sampled and exhibited higher densities in the northern and southern basins of Long Lake. Bladderwort was the next most frequently occurring species, followed by Eurasian watermilfoil, eel grass, Richardson's pondweed, elodea, and variable pondweed.

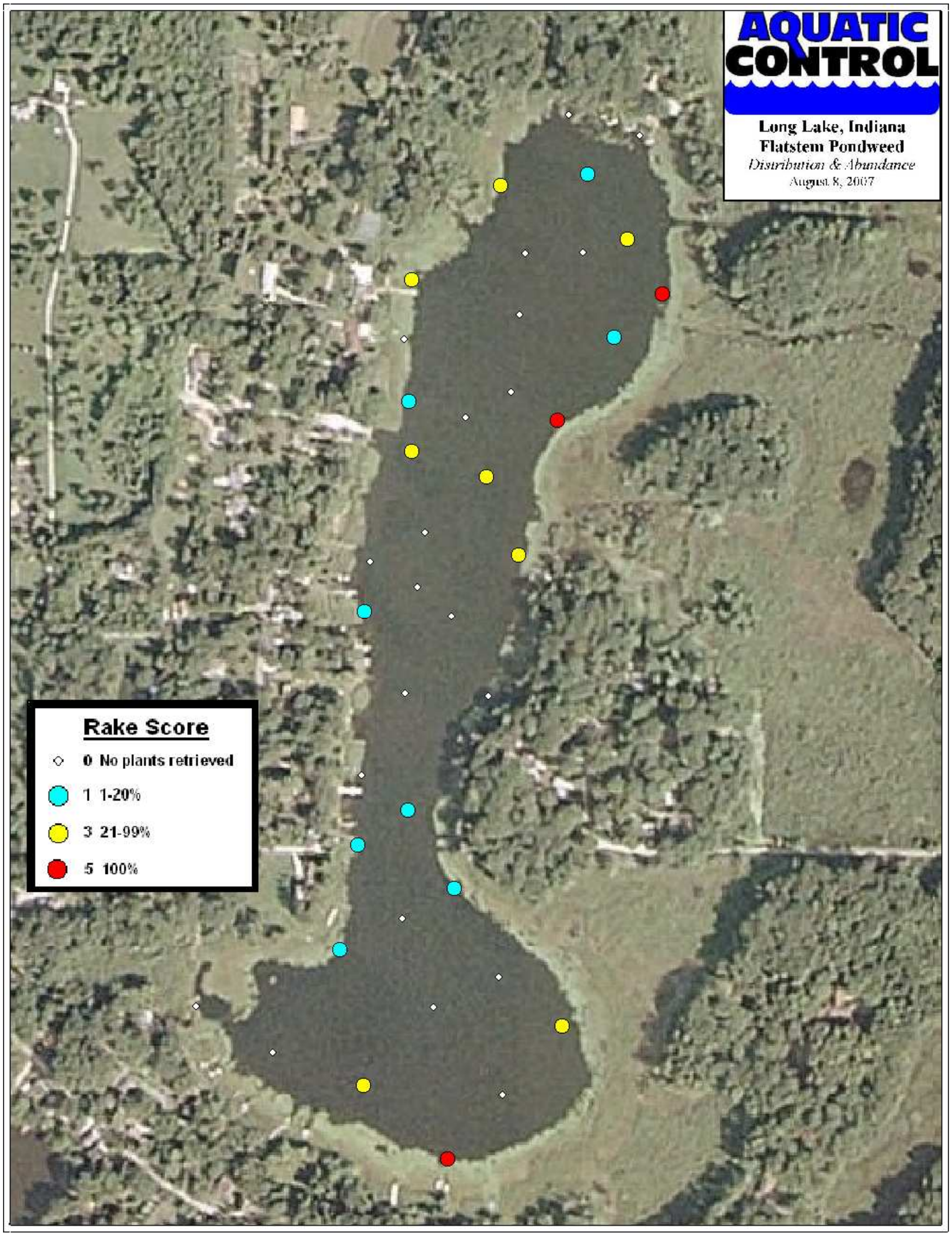

Figure 14. Long Lake, flatstem pondweed distribution and abundance, August 9, 2006.

Eurasian watermilfoil was collected during the summer Tier II survey (Figure 15). The sites of densest Eurasian watermilfoil growth were found on the eastern and western shores on the central part of Long Lake. This plant was also found at three sites along the northern and northeastern shores at lower densities.

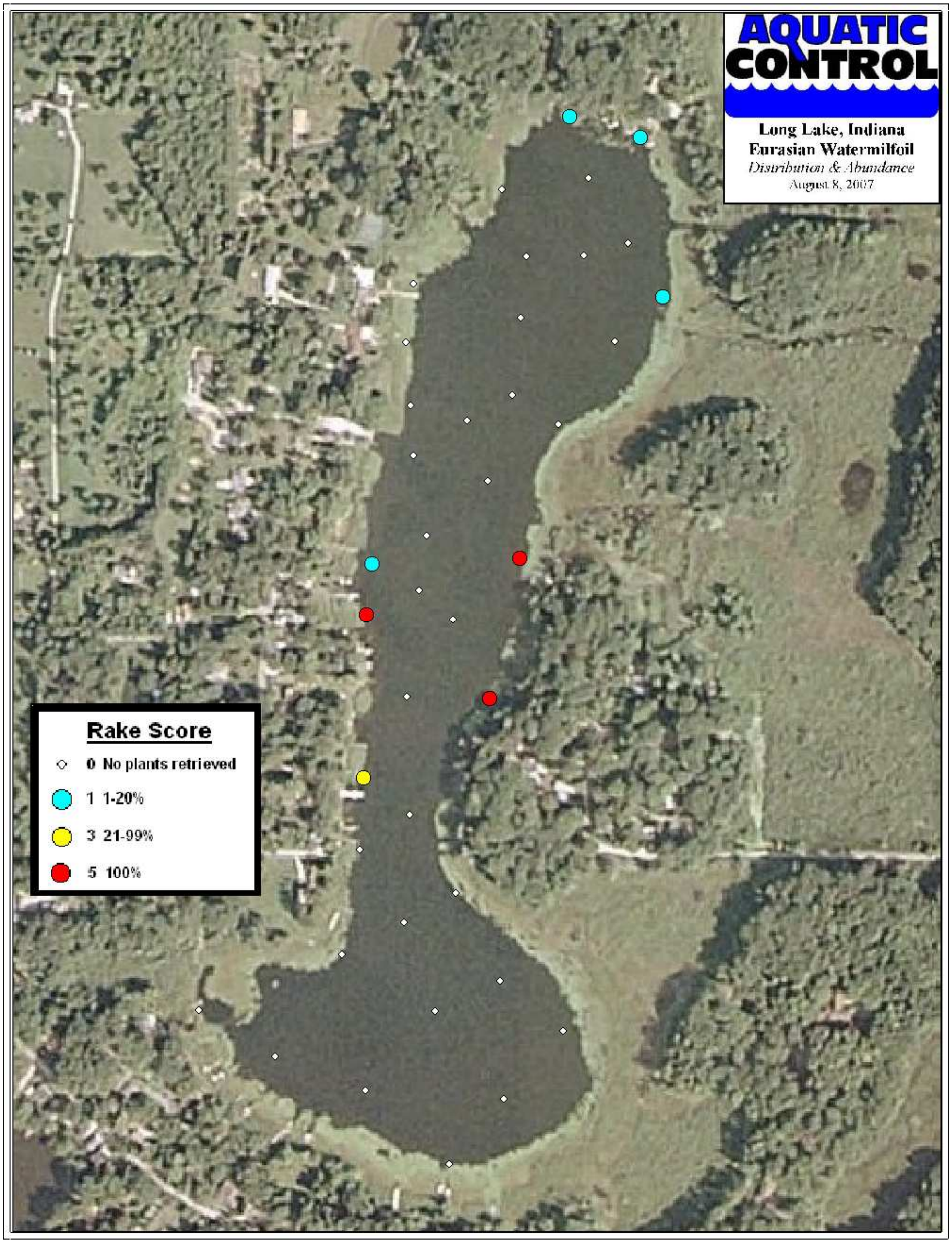

Figure 15. Long Lake, Eurasian watermilfoil distribution and abundance, August 9, 2006..

Richardson's pondweed is listed as a species of concern in Indiana lakes. It was collected at 7.5% of the sampling sites (Figure 16).

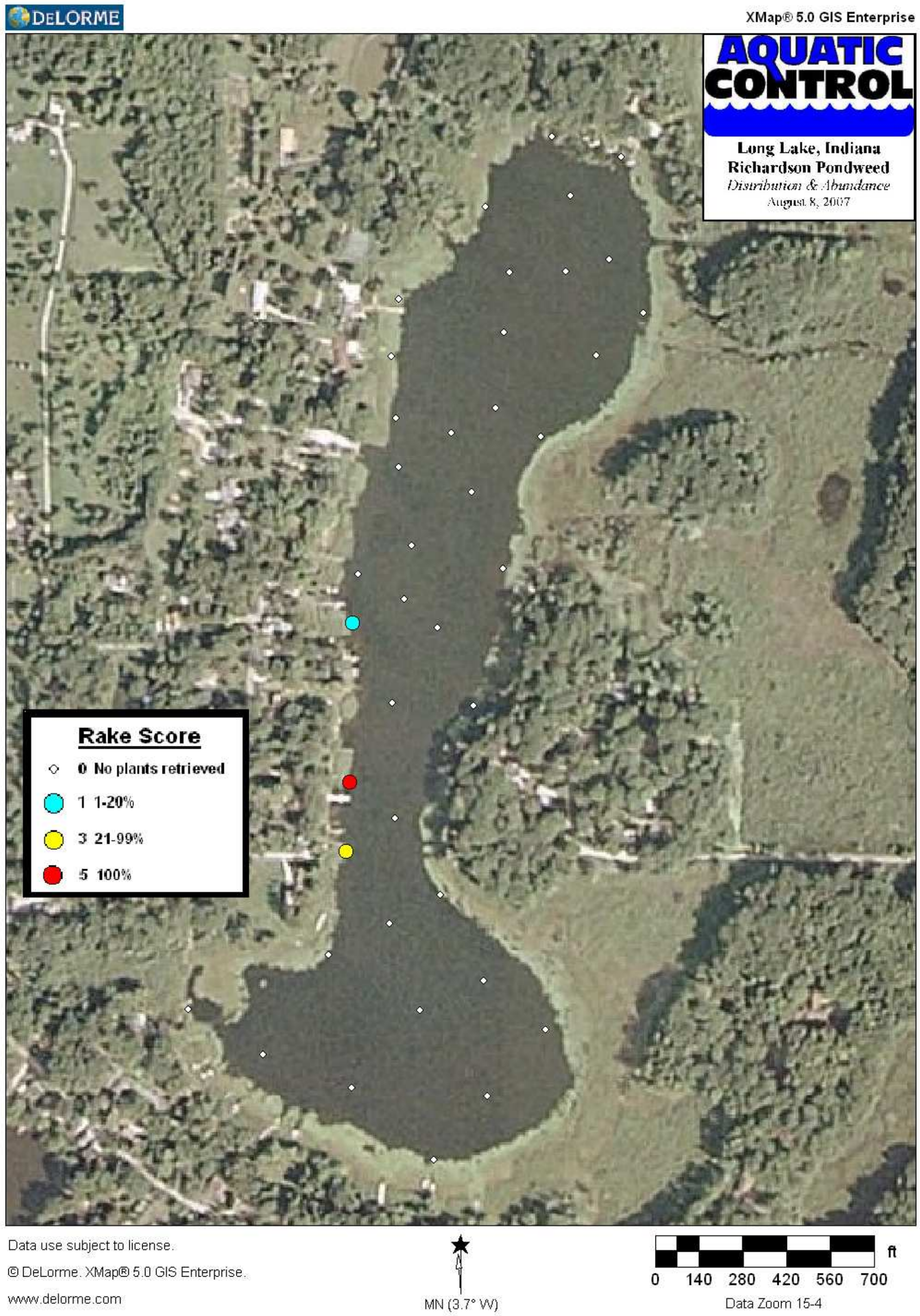

Figure 16. Long Lake, Richardson's pondweed distribution and abundance, August 9, 2006.

8.3 Macrophyte Survey Discussion

According to Secchi measurements, Long Lake has good clarity compared to other Indiana lakes, and thus a relatively diverse aquatic plant community. It also appears the water clarity has increased when compared to past measurements. Ten aquatic species were documented in the spring invasive species mapping and Tier II surveys. Large beds of common coontail, flatstem pondweed, common bladderwort, and eel grass were present in shallow and deep water despite the presence of Eurasian watermilfoil. This vegetation likely provides many benefits to the overall health of Long Lake and should be preserved. Large beds of emergent and rooted floating vegetation dominate the shallow eastern shore and wetland areas.

The presence of Eurasian watermilfoil is the main concern for plant management in Long Lake. This species was very dense in some areas of the lake during the summer survey and present at 20.0% of sample sites (Figure 17). As previously discussed, this species can lead to a wide variety of environmental and recreational problems. Control of this species should be a top priority for lake users.

Figure 17. Eurasian watermilfoil forming a canopy on Long Lake. August 8, 2007

Curlyleaf pondweed was found in the spring, but was not present during the summer survey (Table 4). It was found at relatively low frequency of occurrence (12.5%) and did not grow in high density where it occurred. This exotic species does not seem to be dominating the plant community at the present time, but should be closely monitored in the future to help preserve the native species diversity that exists in Long Lake. Table 4 helps exhibit the tendency of a plant community to change throughout the season. The frequency of occurrence for most of the native species stays constant through the year, but the exotic nuisance species frequencies vary greatly, emphasizing the importance of monitoring a plant community through the growing season.

Table 4. Long Lake, comparison of species by season, 2007

Species	% of survey sites (5/07)	% of survey sites (8/07)
Eurasian watermilfoil *(Myriophyllum spicatum)*		20.0%
curlyleaf pondweed *(Potamogeton crispus)*	12.5%	
common coontail *(Ceratophyllum demersum)*	67.5%	65.0%
eel grass *(Vallisneria americana)*	5.0%	17.5%
American elodea *(Elodea canadensis)*	5.0%	2.5%
flatstemmed pondweed *(Potamogeton zosteriformis)*	55.0%	47.5%
Richardson's pondweed *(Potamogeton richardsonii)*	5.0%	7.5%
variable pondweed *(Potamogeton gramineus)*		2.5%
northern watermilfoil *(Myriophyllum sibiricum)*	20.0%	
common bladderwort *(Utricularia vulgaris)*	47.5%	32.5%

LARE funded surveys focus on submersed vegetation, but the presence of purple loosestrife was noted in the 2007. Purple loosestrife was also documented in previous studies. Steps should be taken to keep this species at a low level.

Common coontail was the most frequently observed species in both 2007 Tier II surveys. This plant can benefit the overall heath of a lake, but has the tendency to create nuisance conditions in shallow water.

9.0 AQUATIC PLANT MANAGEMENT ALTERNATIVES

Long Lake contains a diverse native aquatic plant community that is beneficial to the overall quality of the lake. However, the abundance of dense beds of Eurasian watermilfoil is a cause of concern. This species can create a variety of problems if left unchecked. Eurasian watermilfoil can negatively impact native species abundance, create nuisance conditions, and also negatively effect fish populations. Once established, growth and physiological characteristics of Eurasian watermilfoil enable it to form a surface canopy and develop into immense stands of weedy vegetation, out competing most submersed species and displacing the native plant community (Madsen et al., 1988). Many effective control techniques are available for targeting this species. Curlyleaf pondweed and purple loosestrife are also species that should be considered for control.

In order to develop a scientifically sound and effective action plan for control of nuisance vegetation, all aquatic management alternatives need to be considered. The alternatives that will be discussed include: no action; institutional; environmental manipulation;

mechanical control; manual control; biological control; chemical control; and any combination of these methods.

A number of different techniques have been successfully used to control nuisance vegetation. These techniques vary in terms of their efficacy, rapidity, and selectivity, as well as the thoroughness and longevity of control they are capable of achieving. Each technique has advantages and disadvantages, depending on the circumstances. Selectivity is a particularly important characteristic of control techniques. Nearly all aquatic plant control techniques are at least somewhat selective, in that they affect some plant species more than others. Even techniques such as harvesting that have little selectivity within the areas to which they are applied can be used selectively, by choosing only certain areas in which to apply them. Selectivity can also occur after the fact, as when a technique controls all plants equally but some grow back more rapidly. One facet of selecting an appropriate aquatic plant control technique is matching the selectivity of the control technique with the goals of aquatic plant management. When controlling Eurasian watermilfoil, for example, it is typically desirable to use techniques that control Eurasian watermilfoil with minimal impact on most native species (Smith, 2002).

9.1 No Action

What if no aquatic plant management activity took place on the Long Lake? It seems as if no action has been taken to control invasive nuisance species from the data we have been able to obtain. Eurasian watermilfoil has formed dense monocultures along the western and eastern central shores of the lake. This plant will most likely continue to spread if no action is taken to reduce it. In addition, this species could spread to Flint Lake where IDNR and VLAC have already invested significant funds for the control of milfoil.

9.2 Institutional-Protection of Beneficial Vegetation

Presence of beneficial vegetation can inhibit the growth of species which may be more prone to create nuisance conditions. For example, if a bed of largeleaf pondweed is controlled, that area may be quickly infested by Eurasian watermilfoil. Largeleaf pondweed rarely reaches the surface and if it does, it typically does not develop the density of a milfoil bed. Dense milfoil beds are impossible to boat across, difficult to fish, and provide poor habitat. On the other hand, largeleaf pondweed rarely reaches the density of Eurasian watermilfoil and provides excellent habitat for fish and aquatic invertebrates. Many associations attempt to control all vegetation. This can create a competitive advantage for aggressive species like Eurasian milfoil which can quickly colonize a controlled area. Protection of beneficial vegetation should be part of any vegetation management plan.

9.3 Environmental Manipulation

9.3.1 Water Level Manipulation

Water level manipulation refers to the raising of water levels to control aquatic vegetation by drowning or lowering to control aquatic vegetation by exposing them to freezing, drying or heat. Use of water level manipulation for aquatic plant management is limited to lake and reservoirs with adequate water control structures. Long Lake does not have adequate water control structures, so this technique should not be considered.

9.3.2 Nutrient Reduction

Plant growth can be limited if at least one nutrient, which is critical for growth, is in short supply. Nitrogen, phosphorus, or carbon are usually the nutrients limiting plant growth in lakes. Therefore, if at least one of these nutrients can be limited sufficiently so that plants do not grow to a nuisance level, this nutrient limitation can be used as a method of aquatic plant management. Generally, however, plants in northern Indiana can obtain the majority of necessary nutrients from the soil. Reduction of nutrients can sometimes aggravate existing problems by increasing light penetration leading to an expansion in plant growth (Hoyer & Canfield, 1997). However, in certain situations, nutrient reduction can be effective at controlling overabundant floating vegetation or microscopic algae blooms. It appears that Long Lake has relatively low nutrient levels, but Eurasian watermilfoil is present at moderate levels and creates nuisance conditions.

9.4 Mechanical Control-Harvesting, Cutting, Dredging

Mechanical control includes cutting and/or harvesting of aquatic vegetation or dredging the bottom sediments to eliminate aquatic plant growth. The main advantage to mechanical control is the immediate removal of the plant growth from control areas and the removal of organic matter and nutrients.

One of the most common mechanical control techniques used on larger lakes in Indiana is mechanical harvesting. Mechanical harvesting uses machines which cut plant stems and, in most cases, pick up the cut fragments for disposal. This type of mechanical control has little selectivity. Where a mix of Eurasian watermilfoil and native species exists, harvesting favors the plant species that grow back most rapidly following harvesting. In most cases, Eurasian watermilfoil recovers from harvesting much more rapidly than native plants. Thus, repeated harvesting hastens the replacement of native species by Eurasian watermilfoil and often leads to dense monocultures of Eurasian watermilfoil in frequently harvested areas (Figure 18). Harvesting also stirs up bottom sediments thus reducing water clarity, kills fish and many invertebrates, and hastens the spread of Eurasian watermilfoil via fragmentation.

Figure 18. Picture of a harvester sitting in middle of milfoil bed.

Dredging of shallow areas may reduce nuisance conditions caused by vegetation in the short-term, but studies and personal experience have shown that Eurasian watermilfoil is often the first species to colonize these disturbed areas. Dredging is expensive, especially if a nearby disposal sight is not available. Careful consideration to secondary environmental effects must be considered and permits from regulatory agencies are usually necessary before conducting dredging operations. Dredging is usually short lived if not done deeper than the photic zone.

9.5 Manual Control-Hand Pulling, Cutting, Raking

Removal of small amounts of vegetation by hand, which interfere with beach areas or boat docks, may be the only vegetation control necessary in some areas. Of course, hand removal is labor intensive and must be conducted on a routine basis. The frequency and practicality of continued hand removal will depend on availability of labor, regrowth or reintroduction potential of the vegetation, and the level of control desired (Hoyer & Canfield, 1997). Residents of Long Lake have the option to harvest areas of submersed vegetation in and around their docks or swimming areas. Residents should keep in mind that only a 625 square foot area can be harvested without obtaining a permit from IDNR.

9.6 Biological Controls
Biological controls reduce aquatic vegetation using other organisms that consume aquatic plants or cause them to become diseased. The main biological controls for nuisance vegetation used in Indiana are the grass carp, milfoil weevil, and a variety of insects which prey upon purple loosestrife. Any use of biological controls or stocking fish in public waters in Indiana requires a permit from the IDNR Division of Fish and Wildlife.

9.6.1 Grass Carp
The grass carp (*Ctenopharyngodon idella)* is an herbivorous fish imported from Asia. Triploid grass carp, the sterile genetic derivative of the diploid grass carp, are legal for use in Indiana, but are not permitted for stocking in any natural lakes in the state. Grass carp tend to produce all or nothing aquatic plant control. It is very difficult to achieve a stocking rate sufficient to selectively control nuisance species without eliminating all submersed vegetation. They are not particularly appropriate for Eurasian watermilfoil control because this species is low on their feeding preference list; thus, they eat most native plants before consuming Eurasian watermilfoil (Smith, 2002). Grass carp are also difficult to remove from a lake once they have been stocked. Due to the legal concerns and ineffectiveness of the grass carp to correct the problem, grass carp are not recommended for nuisance vegetation control in the Long Lake.

9.6.2 Milfoil Weevil
The milfoil weevil, *Euhrychiopsis lecontei,* is a native North American insect that consumes Eurasian and Northern watermilfoil. The weevil was discovered following a natural decline of Eurasian watermilfoil in Brownington Pond, Vermont (Creed and Sheldon, 1993), and has apparently caused declines in several other water bodies. Weevil larvae burrow in the stem of Eurasian watermilfoil and consume the vascular tissue thus interrupting the flow of sugars and other materials between the upper and lower parts of the plant. Holes where the larvae burrow into and out of the stem allow disease organisms a foothold in the plants and allow gases to escape from the stem, causing the plants to lose buoyancy and sink (Creed et al. 1992).

Concerns about the use of the weevil as a biological control agent relate to whether introductions of the milfoil weevil will reliably produce reductions in Eurasian watermilfoil and whether the resulting reductions will be sufficient to satisfy users of the lake (Smith, 2002). Following our research, no conclusive data concerning the role of weevils in reducing Eurasian watermilfoil populations has been made available. In 2003, Scribailo and Alix conducted a weevil release study on three Indiana lakes and had no conclusive evidence supporting the use of weevils in reducing milfoil populations. Weevils may reduce milfoil populations in some lakes, but predicting which lakes and how much, if any, control will be achieved has not been documented (Scribailo & Alix, 2003).

9.6.3 Purple Loosestrife Insects (Summarized from JFNew & Associates, 2005)
Some control of purple loosestrife has been achieved through the use of several insects. A pilot project in Ontario, Canada reported a decrease in 95% of the purple loosestrife

population from pretreatment population (Cornell Cooperative Extension, 1996 cited in JFNew, 2005). Four different insects were used to achieve this control. These insects have been identified as natural predators of purple loosestrife in its native habitat. Insect releases in Indiana to date have had mixed results. After six years, the loosestrife of Fish Lake in LaPorte County is showing signs of deterioration. Likewise, seven years after the release at Pleasant Lake in St. Joseph County, purple loosestrife populations appear to have declined around the boat ramp (IDNR, 2004 cited in JFNew, 2005). Biological control is not a quick solution; many estimates suggest that it may take 5-15 years to achieve a large impact on purple loosestrife populations.

9.7 Chemical Control

Chemical control uses chemical herbicides to reduce or eliminate aquatic plant growth. The main disadvantage to the use of chemicals is the publics concern over safety. Extensive testing is required of aquatic herbicides to ensure that the herbicides are low in toxicity to human and animal life and they are not overly persistent or bioaccumulated in fish or other organisms. It often takes several decades of testing by the Environmental Protection Agency (E.P.A.) before a herbicide is approved for aquatic use. After E.P.A approval and registration, the herbicide must go through the registration process in each state.

Another disadvantage to the use of aquatic herbicides is water use restrictions. These restrictions must be posted prior to treatment on a public body of water. The most common restriction is irrigation. Another disadvantage to the use of herbicides is the release of nutrients that can occur if large areas of vegetation are controlled. This can be avoided by early application that controls vegetation before it reaches its maximum biomass. These perceived disadvantages are often times out-weighed by this technique’s proven rapid effectiveness and selectivity.

There are two different types of aquatic herbicides, systemic and contact. Systemic herbicides are translocated throughout the plants and thereby kill the entire plants. Fluridone (trade name Sonar & Avast!), 2,4-D (trade name Navigate, Aqua-Kleen, & DMA4 IVM), and triclopyr (trade name Renovate) are systemic herbicides that can effectively control Eurasian watermilfoil. Triclopyr, imazypry, and glyphosate are systemic herbicides that can control purple loosestrife.

Based upon Aquatic Control’s first hand experience and personal communication with an array of North American aquatic plant managers, it appears that whole-lake fluridone applications are by far the most effective means of controlling Eurasian watermilfoil. Successful fluridone treatments yield a dramatic reduction in the abundance of Eurasian watermilfoil, often reducing it to the point that Eurasian watermilfoil plants are difficult to detect following treatment (Smith, 2002). An advantage to using fluridone over most contact herbicides is its selectivity. Most strains of Eurasian watermilfoil have a lower tolerance to fluridone than the majority of native species, so if the proper rates are applied Eurasian water milfoil can be controlled with little harm to the majority of native species.

Triclopyr is a systemic herbicide that has recently been approved for use in aquatics. Triclopyr typically is used for treating isolated milfoil beds as opposed to whole lake treatments. This herbicide is very selective to Eurasian watermilfoil. A study was conducted in 1997 during the registration process of this herbicide. The study found Eurasian watermilfoil biomass was reduced by 99% in treated areas at 4 weeks post-treatment, remained low one year later, and was still at acceptable levels of control at two years post-treatment. Non-target native plant biomass increased 500-1000% by one year post-treatment, and remained significantly higher in the cove plot at two years post-treatment. Native species diversity doubled following herbicide treatment, and the restoration of the community delayed the re-establishment and dominance of Eurasian watermilfoil for three growing seasons (Getsinger et. al., 1997). Triclopyr is a good alternative to fluridone when Eurasian watermilfoil is not abundant throughout an entire water body. It would likely be impossible to completely eliminate Eurasian watermilfoil with this type of herbicide, but an aggressive treatment program could significantly reduce milfoil density and abundance to a more manageable level. Eurasian watermilfoil must be treated everywhere it is located in the lake. The only water use restriction following a triclopyr treatment is irrigation. An assay is needed to monitor the concentration in the water before irrigation can take place. One of the drawbacks to using triclopyr has been the fact that only a liquid formulation has been available. This can dramatically increase costs for treatment in deep water areas. In 2007, a granular formulation called Renovate OTF was approved for aquatic use in Indiana.

Applied properly, 2,4-D can also yield major reductions in the abundance of Eurasian watermilfoil. Much like triclopyr, treatments must be even and dose rates accurate. This formulation should be used much like Triclopyr. Unlike Triclopyr, 2,4-D can impact the native species coontail. This herbicide can be applied for less cost than triclopyr, but damage will likely occur to coontail. 2,4-D herbicide should be considered as an alternative to triclopyr applications if the Association's budget is restricted. 2,4-D is also available in liquid and granular formulations.

Contact herbicides can also be effective for controlling submersed vegetation in the short term. The three primary contact herbicides used for control of submersed vegetation are diquat (trade name Reward), endothal (trade name Aquathol), and copper based formulations (trade names Komeen, Nautique, and Clearigate).

Historically, a drawback to the use of contact herbicides has been the lack of selectivity exhibited by these herbicides. However, a study completed by Skogerboe and Getsinger in 2002 outlines how endothal can be used for control of the exotic species curlyleaf pondweed and Eurasian watermilfoil with little effect on the majority of native species. They found early season treatments with endothall effectively controlled Eurasian watermilfoil and curlyleaf pondweed at several application rates with no regrowth eight weeks after treatment. Sago pondweed, eel grass, and Illinois pondweed biomass were also significantly reduced following the endothall application, but regrowth was observed at eight weeks post-treatment. Coontail and elodea showed no effects from endothall at three of the lower application rates. Spatterdock, pickerelweed, cattail, and smartweed were not injured at any of the application rates (Skogerboe & Getsinger 2002). This type of treatment strategy could be applied to lakes that have large areas of both curlyleaf pondweed and Eurasian watermilfoil. Endothal could also be effective the year after whole lake sonar treatments where curlyleaf pondweed typically returns the following season.

Diquat and many of the copper formulations are effective fast acting contact herbicides. These formulations are typically used when control of all submersed vegetation is desired. These herbicides are commonly used for control of nuisance vegetation around docks and near-shore high-use areas. Diquat and the copper based herbicides are not as selective as many of the other herbicides and plants can often time recover in 4-8 weeks after treatment. There are no water use restrictions following the use of chelated copper based herbicide, which makes them popular choices for lakes used for irrigation or drinking water.

10.0 PUBLIC INVOLVEMENT

An effective aquatic vegetation management plan must include input from lake users. A public meeting was conducted on October 17, 2007 at the Flint Lake Church of Christ. The meeting was advertised in the local newspaper and on the VLACD website. Approximately twelve individuals attended the meeting. A meeting for Flint Lake was held prior to the Long Lake meeting.

The goals of the meeting were as follows:

1. Inform lake users of the planning process
2. Document important high-use areas of the lake
3. Educate those in attendance on aquatic plant ecology
4. Describe results of the plant sampling
5. Discuss plant management alternatives
6. Discuss implementation of the potential management strategies and monitoring programs
7. Obtain user input by filling out a survey (see appendix for survey form)

Table 5 shows the results from the public survey. According to surveys forms, 60% of those who responded were property owners on Long Lake. Forty percent were currently members of the lake association. Sixty percent of those surveyed used the lake for boating and fishing, 40% for swimming, and none of those surveyed used the lake for irrigation.

On survey questions concerning lake problems; 60% believed there were too many aquatic plants, 40% thought there was a fish population problem, 20% believed that dredging was needed, 20% of those surveyed believed there was too much fishing, 20% thought that there were too many boats with access to the lake, 20% believed there was overuse by nonresidents, none thought there was a water quality problem, none thought that there was not enough vegetation, none believed there were pier/funneling problems, and none believed that jet skis were a problem.

On survey questions dealing with aquatic vegetation; 80% believed vegetation interfered with lake use, 60% believed it affected property value, 60% believed vegetation was at a nuisance level, and 60% were in favor of continuing vegetation control efforts (40% did not respond to this question).

Table 5. 10/17/07 Public meeting survey results

Long Lake User Survey 10/17/07		
Are you a lake property owner?	Yes 60%	No 40%
Are you currently a member of your lake association?	Yes 40%	No 40%
How many years have you been at the lake?	2 or Less: 0%	5 to 10: 40%
	2 to 5: 0%	Over 10: 20%
How do you use the lake (mark all that apply)	40% Swimming	% Irrigation
	60% Boating	0% Drinking water
	60% Fishing	0% Other _______
Do you have aquatic plants at your shoreline in nuisance quantities?	Yes: 60% No: 20%	20% no reponse
Does aquatic vegetation interfere with your use or enjoyment of the lake?	Yes: 80% No: 0%	20% no response
Does the level of vegetation in the lake affect your property values?	Yes: 60% No: 20%	20% no response
Are you in favor of continuing efforts to control vegetation on the lake?	Yes: 60% No: 0%	40% no response
Are you aware that the LARE funds will only apply to work controlling invasive exotic species, and more work may need to be privately funded?	Yes: 80% No: 0%	20% no response
Mark any of these you think are problems on your lake:		
20% Too many boats access the lake		
0% Use of jet skis on the lake		
20% Too much fishing		
40% Fish population problem		
20% Dredging needed		
20% Overuse by nonresidents		
60% Too many aquatic plants		
0% Not enough aquatic plants		
0% Poor water quality		
0% Pier/funneling problem		

Another topic discussed at the public meeting was the recent discovery of hydrilla (*Hydrilla verticillata*) in Lake Manitou. Hydrilla is an invasive aquatic species that was originally discovered in Florida in the 1960's. There are many characteristics of hydrilla that make it a threat to Indiana waterways. This species can grow in lower light conditions than most native species, grows faster than most native species, and can shade out other species by forming a surface canopy. Hydrilla can be easily confused with native elodea. The best way to distinguish hydrilla from native elodea is that hydrilla typically has five leaves along each whorl along with visible serrated edges along the leaf margin (Figure 19). What makes controlling the spread of hydrilla difficult is the fact that it can be spread by fragments. **That is why it is vitally important that lake users remove all plants and sediment from their boats when entering and leaving the**

Valparaiso Chain of Lakes. At this time, hydrilla has not been discovered in Long Lake. More information about controlling the spread of hydrilla can be found at www.protectyourwaters.net.

Figure 19. Illustration of hydrilla on the left compared to native elodea on the right. Hydrilla typically contains five toothed leaves per whorl while native elodea typically has three leaves per whorl and the teeth are not visible on the leaves (Illustrations provided by Applied Biochemist).

11.0 PUBLIC EDUCATION

In order to effectively manage aquatic vegetation lake users must gain an understanding of the ecology of the lake ecosystem and the effects individual actions may have on this resource. The Valparaiso Lakes Area Conservancy District should be commended on their efforts to understand and improve the lakes and surrounding watershed. Numerous studies and activities have been commissioned by VLACD. However, it is still important to continue education efforts in order to reinforce many of the actions that have been recommended by these studies. The following is a list of potential actions that individuals can undertake:

1. Reduce the frequency and amount of fertilizer, herbicide, or pesticide used for lawn care.
2. Use only phosphorus-free fertilizer.
3. Consider re-landscaping lawn edges, particularly those along the watershed's lakes, to include low profile prairie species that are capable of filtering runoff water better than turf grass
4. Consider resurfacing concrete or wooden seawalls with glacial stone, then planting native emergent vegetation along shorelines or in front of resurfaced or existing concrete or wooden seawalls to provide fish and invertebrate habitat and dampen wave energy.

5. Keep organic debris like lawn clipping, leaves, and animal waste out of the water
6. Examine all drains that lead from roads, driveways, and rooftops to the watershed
7. Obey speed limits through the lakes
8. Clean all plant fragments and sediment from boats, propellers, and trailers after lake use and refrain from dumping bait buckets into the lake to prevent the spread of exotic species (JFNew 2003). Additional information on stopping the spread of exotic species can be found at www.protectyourwaters.net.

These points should be reinforced annually at VLACD meetings, in newsletters, and on the website.

12.0 INTEGRATED MANAGEMENT ACTION STRATEGY

The focus of the action strategy should be designed to meet the goals and objectives of the aquatic plant management plan. To review, the goals are as follows:

1. Maintain a stable, diverse aquatic plant community that supports a good balance of predator and prey fish and wildlife species, good water quality, and is resistant to minor habitat disturbances and invasive species
2. Direct efforts to preventing and/or controlling the negative impacts of aquatic invasive species.
3. Provide reasonable public recreational access while minimizing the negative impacts on plant and fish and wildlife resources.

Each goal, along with objectives to meet this goal, is listed below. Following each objective are the actions which should be taken in order to achieve the objective.

12.1 Goal #1-Maintain Stable and Diverse Native Population

The first goal focuses on developing or maintaining a stable, diverse aquatic plant community. In order to address the objectives for meeting this goal the plant community will be divided into two categories: emergent/floating vegetation and submersed vegetation. The focus of the LARE program is primarily on control of nuisance exotic submersed vegetation, but seeing how this is an aquatic vegetation management plan one cannot ignore the emergent and rooted floating plant community.

Objective 1: Maintain and Enhance Diversity of the Rooted Floating/Emergent Aquatic Plant Community

Long Lake has a fairly large area of rooted floating and emergent vegetation surrounding most of the lake. Large areas of the shallow eastern part of the lake contain dense stands of spatterdock, arrow arum, pickerel weed, hibiscus white water lily, swamp loostrife, cattail, and button bush. This community serves several beneficial purposes to Long Lake that includes reducing erosion, providing fish and wildlife food and habitat, and filtering excessive nutrients. These plant communities should be protected from development. New developments should consider natural shorelines that allow emergent and rooted floating vegetation to grow. A dense shallow water plant community should help reduce erosion, prevent geese from entering and exiting the lake, provide cover for fish and wildlife, and help filter nutrients that may enter the lake from developed sites. Figure 20 is an example of a developed shoreline on Crooked Lake in Steuben County. This home site has allowed native vegetation to flourish along their shoreline yet still has good lake access.

Figure 20. Crooked Lake, emergent plant community along developed shoreline, June 2006.

In previous surveys, purple loosestrife was found at high levels within the emergent plant beds surrounding Long Lake. This plant has the potential to spread and displace beneficial native species. To date the LARE program has not funded control of this plant, so it is important that residents take action in securing funds from other sources and conduct their own controls. Residents should become familiar with this species and dig it up if it is found on their property. Biological controls show a lot of promise and are less expensive and controversial than herbicide applications. The association should stay abreast of any funding or studies being completed with these biological controls and make all attempts to secure funds.

Objective 2: Maintain density and diversity of submersed vegetation.

Long Lake has a relatively good density and diversity of submersed vegetation. This vegetation provides fish cover, filters nutrients, and is vital to the overall ecology of Long Lake. Lake users need to be educated on the benefits of this vegetation. Native vegetation should only be controlled where it is obviously negatively impacting lake use. Residents should keep in mind that a few native plants around a dock area do not negatively impact lake use. Reduction in Eurasian watermilfoil should also reduce competition with native vegetation. Once the milfoil is controlled native plants should increase in abundance.

12.2 Goal #2-Reduce Negative Impacts Caused by Exotic Vegetation
The second goal of the vegetation management plan is to prevent and reduce negative impacts of aquatic invasive species. Goal one and two are somewhat related because one of the negative impacts of invasive species is their tendency to displace beneficial native vegetation.

Objective 1: Reduce and control Eurasian watermilfoil density and abundance
One of the main invasive species of concern is Eurasian watermifilfoil. Eurasian watermilfoil reproduces through fragmentation and can rapidly reach nuisance levels. This makes it of special concern when it comes to aquatic plant management. This species can also displace native vegetation due to this rapid growth and its tendency to form canopies shading out native species.

Whole lake fluridone treatments have historically been the best method for long-term control of Eurasian watermilfoil. This technique is not ideal for Long Lake since there is an abundance of Eurasian watermilfoil in other lakes that are connected to Long and Eurasian watermilfoil is isolated to just a few areas along the shoreline. The benefits of a whole lake treatment would likely be short-lived. The costs of a whole lake treatment would likely outweigh the benefits.

It is the opinion of Aquatic Control that the best action plan for controlling Eurasian watermilfoil in Long Lake involves the use of Renovate herbicide (active ingredient triclopyr). This action will be very selective towards Eurasian watermilfoil and has the potential to provide long-term control. Another advantage to the use of triclopyr for the control of Eurasian watermilfoil is that it will not harm some of the beneficial native plants such as coontail. In addition, this technique effectively controlled milfoil in Flint Lake which is connected to Long Lake. In order to effectively complete this treatment, areas containing Eurasian watermilfoil will have to be mapped out prior to treatment. All areas containing Eurasian watermilfoil should be treated in late spring, following creation of a treatment map. These areas should be treated with 1.25-1.5 ppm of triclopyr. Treatments will likely need to be repeated the following season due to the difficulty in finding and controlling all milfoil plants and due the presence of this species in other connected lakes. However, the abundance of this species should be significantly reduced in following years. The goal of this control is to keep Eurasian watermilfoil frequency of occurrence below 5% so that the Conservancy can easily fund future controls. Based on this years sampling, approximately 10 acres will require treatment. Further investigation should be made into the claim that some lake residents are still using Long Lake as a drinking water source. Non-turf irrigation will be the primary water-use restriction following treatment. Typically, after 7-14 days, triclopyr levels are low enough to irrigate. However, in order to be certain that these levels are low enough, an assay should be completed before irrigation is allowed. There are no swimming or fishing restrictions associated with use of this herbicide.

Along with chemical control, it will be important for lake users to do their part in controlling Eurasian watermilfoil. Eurasian watermilfoil spreads through fragmentation, so it is easy to introduce this species to new areas. It is important that boaters avoid driving through any milfoil beds. This can chop up the plants causing them to float into new areas. It is also important that boaters check their props and trailers when traveling from lake to lake removing any plant fragments. One fragment of milfoil can lead to an entire colony. Signs should also be placed at all access points warning boaters to check for plant fragments. This is especially important since the discovery of hydrilla (*Hydrilla verticillata)* in Lake Manitou.

Objective 2: Prevent further spread of Purple Loosestrife
As mentioned when discussing goal number one, purple loosestrife can be detrimental to native wetland species. Control of this species will not be funded by LARE due to the extent of the problem, expense associated with control efforts, and controversy surrounding control on private property. If this species is discovered on one's property, it will be important to individual homeowners to dig up and remove the entire plant. An illustration of this species was included in Figure 5 located on page 7 of this plan.

Objective 3: Monitor curlyleaf pondweed and control if necessary
The exotic species, curlyleaf pondweed is common to northern Indiana lakes, and was found at low levels during surveys of Long Lake. Historically, control of this species has not been funded by the LARE program due to limitations of funding that require prioritization of the most aggressive species. Curlyleaf pondweed tends to senesce during the busy summer season. After Eurasian watermilfoil is under control it may become economically feasible to begin controlling curlyleaf pondweed. Control of this species will require multiple seasons of treatment due to the presence of curlyleaf pondweed turions, which may last several seasons after treatment. Low dose endothal treatments are effective for selective control of curlyleaf pondweed.

Objective 4: *Create public awareness of the potential for hydrilla invasion and post signs for cleaning off boats at all private and public access sites*
Hydrilla, an extremely aggressive submersed aquatic plant species, has been recently discovered in Lake Manitou, which is located in north central, Indiana. Currently, it is believed that this plant is isolated in the Lake Manitou area, but much like Eurasian watermilfoil, this species has the ability to reproduce by fragmentation. This allows it to be spread easily from lake to lake. It is very important that lake users understand the importance of thoroughly cleaning off their boats when entering and exiting Long Lake. Posting signs at the ramp will help reinforce this point. Warnings about this plant should also be sent to members of the Association. The best way to distinguish hydrilla from native elodea is that hydrilla typically has five leaves along each whorl along with visible serrated edges along the leaf margin (Figure 9). More information about controlling the spread of hydrilla can be found at www.protectyourwaters.net.

12.3 Goal #3-Provide Reasonable Recreational Access While Minimizing the Negative Impacts on Plant, Fish, and Wildlife Resources
The focus of plant control should be on nuisance exotic species, but even if all exotic species were eliminated it may be necessary to control some native plants in order to provide access to docks and high-use areas.

Objective 1: Control vegetation around docks and the boat ramp in order to allow for boat access
If left unchecked, some homeowners may be negatively impacted by native vegetation. Some homeowners may have the ability to physically remove the vegetation from these areas (625 square feet can be removed without a permit). It is recommended that if possible, and if needed, homeowners control only 625 square feet. However, some areas may be too dense or some homeowners may not be capable of completing this task. In this case it will be necessary to contact professionals to complete the work. Applied properly, aquatic herbicides are typically the best method for control of dense vegetation growth. Treatment should be limited to near shore high-use areas. Width of shoreline treatments should not exceed 100 feet out from shore. Treatment of rooted floating vegetation should be limited to a wide enough area for boats to pass (20-30 feet). It has also been IDNR's policy to only permit treatment of native vegetation in half of the shoreline areas of any given lake.

12.4 List of Actions To Be Initiated
The purpose of the LARE grant was to fund aquatic vegetation control on public lakes. Listed below, in order of importance, are recommended actions in order to meet the goals and objectives of the aquatic vegetation management plan. Some of these actions may be funded by LARE, but many will require funds from the Association.

1. Initiate treatment of Eurasian watermilfoil in Long Lake with Renovate herbicide. Treatment should take place in the spring of 2008 following sampling that will determine actual treatment areas. Triclopyr should be applied at 1.25-1.50 ppm. Treatment will likely be needed the following seasons and should be included in the long-term budget.
2. Monitor plant community with plant surveys for next five years in order to assess the effectiveness of controls and response of native plant community. Plant surveys will also be invaluable to quickly detect and control potential reinfestation of Eurasian watermilfoil. Surveys should consist of a spring pre-treatment survey for invasive species and a summer Tier II survey in 2008. These surveys should be continued through 2012.
3. Post signs at access sites warning boaters of the potential for invasive plant species introductions from boat trailers. Signs should implore boaters to clean trailers, props, and boats of all vegetation fragments when entering and leaving Long Lake. Information concerning the potential spread of Eurasian watermilfoil and hydrilla should be distributed to all Conservancy members and lake users.
4. Remove purple loosestrife from individuals' property and pursue funding source to biological controls.

5. Maintain dock areas with physical plant removal when possible or by contracting professional applicators. Treatments should not exceed 100 feet from shoreline for submersed vegetation and treatment of rooted floating vegetation should be limited to boating lanes.
6. Educate lake users on best management practices in order to improve water quality.
7. Monitor curlyleaf pondweed population and consider control after Eurasian watermilfoil is reduced.

13.0 PROJECT BUDGET

Table 6 is an estimated budget for the aquatic vegetation management action plan. The majority of the initial cost will be for treatment of Eurasian watermilfoil. It is hard to predict how much milfoil will return in following years, but the estimate below is based on past experience. Plant sampling will be one of the most important actions in order to monitor the effects of the control techniques. Sampling should consist of a spring pre-treatment survey to map treatment areas along with a Tier II survey in the summer. It is proposed that IDNR fund treatment of milfoil and plant survey updates (this will require a 10% match from the Association). **It is our recommendation that the Valparaiso Lakes Area Conservancy District requests $5,000 for treatment of approximately 11 acres of Eurasian watermilfoil in 2008. The Association should also request $4,000 for plant sampling and plan updates.** Curlyleaf pondweed should also be monitored in years following the Renovate treatments. Curlyleaf pondweed was found in just 1.25 acres of the lake at the time of the spring survey in 2007. A permit has been created for the milfoil treatment and is included in the Appendix. This permit should be handled by the association and once a contractor is selected for the treatment the permit can be completed. It is possible that this project may not be fully funded due to a recent hydrilla infestation in Lake Manitou that may use a large percentage of potential LARE funds.

Table 6. Budget estimate for action plan

	2008	2009	2010	2011	2012
Selective treatment of Eurasian watermilfoil with Renovate herbicide	$5,000	$4,000	$3,000	$2,000	$1,000
Plant sampling and plan updates (potential LARE funding with 10% match)	$4,000	$4,000	$4,000	$4,000	$4,000
Total:	**$9,000**	**$8,000**	**$7,000**	**$6,000**	**$5,000**

14.0 MONITORING AND PLAN UPDATE PROCEDURES

One of the most important actions in the aquatic vegetation management plan is the continued monitoring of the plant population. Continued monitoring will provide valuable data to the aquatic plant manager. This data can be used to complete the following tasks: allow for needed changes to be made to the plan; monitor success or failure of controls; monitor improvements or damage to native plants; and detect potential new invasive species at an early stage of infestation. In 2008, monitoring should consist of a treatment map survey in the spring along with a Tier II survey in July or August.

The Tier II survey provides managers with quantitative data that can point out trends in the plant community. Each winter this data should be analyzed and included in an update to the aquatic vegetation management plan. The surveys may lead to changes in the recommended actions of the plan.

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16.0 APPENDICIES

16.1 Data Sheets

Lake	Date	Latitude	Longitude	Site	Depth	RAKE	curlyleaf pondweed (*Potamogeton crispus*) POCR3	common coontail (*Ceratophyllum demersum*) CEDE4	eel grass (*Vallisneria americana*) VAAM3	American elodea (*Elodea canadensis*) ELCA7	flatstemmed pondweed (*Potamogeton zosteriformis*) POZO	Richardson's pondweed (*Potamogeton richardsonii*) PORI2	northern watermilfoil (*Myriophyllum sibiricum*) MYSI	common bladderwort (*Utricularia vulgaris*) UTMA
Long	5.15.07	41.524315	-87.050612	1	11.0	5		5			1			1
Long	5.15.07	41.523629	-87.050464	2	16.0									
Long	5.15.07	41.522943	-87.05115	3	7.0	5		3						5
Long	5.15.07	41.522247	-87.05069	4	15.0									
Long	5.15.07	41.521551	-87.051187	5	5.0	1		1			1	1		1
Long	5.15.07	41.520944	-87.051228	6	8.0	5		5		1				1
Long	5.15.07	41.520321	-87.050718	7	15.0									
Long	5.15.07	41.52005	-87.051433	8	7.0	3		1			1		1	3
Long	5.15.07	41.519575	-87.053062	9	4.0	1		1						1
Long	5.15.07	41.519179	-87.052194	10	19.0									
Long	5.15.07	41.518888	-87.051163	11	11.0	5		5			1			
Long	5.15.07	41.518264	-87.0502	12	5.0	5		5			1			1
Long	5.15.07	41.518814	-87.049577	13	20.0									
Long	5.15.07	41.519394	-87.0489	14	8.0	5		5	1		1		1	1
Long	5.15.07	41.519825	-87.049617	15	17.0	5		5			1			
Long	5.15.07	41.519562	-87.05036	16	14.0									
Long	5.15.07	41.520573	-87.05013	17	7.0	3		3						
Long	5.15.07	41.521239	-87.05065	18	11.0	5	1	5			1			1
Long	5.15.07	41.522228	-87.049744	19	3.0	5	1	5		1			1	
Long	5.15.07	41.522915	-87.050158	20	20.0									
Long	5.15.07	41.523429	-87.049392	21	5.0	5		5			1	1		1
Long	5.15.07	41.524092	-87.049766	22	12.0	5	3	5			1			
Long	5.15.07	41.524582	-87.048958	23	6.0	5		1			1		1	5
Long	5.15.07	41.524832	-87.049481	24	16.0									
Long	5.15.07	41.525292	-87.04831	25	15.0	1		1			1			
Long	5.15.07	41.525657	-87.047754	26	6.0	3		3					1	3
Long	5.15.07	41.526126	-87.04816	27	10.0	1	1	1			1			1
Long	5.15.07	41.52602	-87.048662	28	17.0	1					1			
Long	5.15.07	41.527018	-87.048019	29	3.0	5		1			1			5
Long	5.15.07	41.527195	-87.048828	30	4.0	5		5	1		1			5
Long	5.15.07	41.526682	-87.048608	31	14.0	5		5			1			
Long	5.15.07	41.526589	-87.0496	32	7.0	3	1	3			1		1	1
Long	5.15.07	41.526018	-87.049319	33	16.0	1					1			
Long	5.15.07	41.525489	-87.049385	34	16.0									
Long	5.15.07	41.525781	-87.050611	35	4.0	3		3			1		1	1
Long	5.15.07	41.525277	-87.050698	36	4.0	1		1			1		1	1
Long	5.15.07	41.524744	-87.050644	37	5.0	1		1						1
Long	5.15.07	41.524611	-87.049997	38	15.0									
Long	5.15.07	41.523378	-87.051083	39	10.0	1		1			1			
Long	5.15.07	41.523163	-87.050548	40	16.0									

Lake	Date	Latitude	Longitude	Site	Depth	RAKE	Eurasian watermilfoil (*Myriophyllum spicatum*) MYSP2	common coontail (*Ceratophyllum demersum*) CEDE4	eel grass (*Vallisneria americana*) VAAM3	American elodea (*Elodea canadensis*) ELCA7	flatstemmed pondweed (*Potamogeton zosteriformis*) POZO	Richardson's pondweed (*Potamogeton richardsonii*) PORI2	variable pondweed (*Potamogeton gramineus*) POGR8	common bladderwort (*Utricularia vulgaris*) UTMA
Long	8/8/07	41.5243	-87.050612	1	11.0	5					3			
Long	8/8/07	41.5236	-87.050464	2	16.0	0								
Long	8/8/07	41.5229	-87.05115	3	4.0	5	5		1		1	1		
Long	8/8/07	41.5222	-87.05069	4	14.0	0								
Long	8/8/07	41.5216	-87.051187	5	5.0	5	3	5	3			5		
Long	8/8/07	41.5209	-87.051228	6	6.0	5		5	3		1	3		3
Long	8/8/07	41.5203	-87.050718	7	15.0	0								
Long	8/8/07	41.5201	-87.051433	8	9.0	5		5			1			5
Long	8/8/07	41.5196	-87.053062	9	17.0	1		1						
Long	8/8/07	41.5192	-87.052194	10	19.0	0								
Long	8/8/07	41.5189	-87.051163	11	10.0	5		5			3			
Long	8/8/07	41.5183	-87.0502	12	7.0	5		5			5			5
Long	8/8/07	41.5188	-87.049577	13	19.0	0								
Long	8/8/07	41.5194	-87.0489	14	8.0	5		5			3			3
Long	8/8/07	41.5198	-87.049617	15	12.0	5		5						
Long	8/8/07	41.5196	-87.05036	16	13.0	1		1						
Long	8/8/07	41.5206	-87.05013	17	9.0	5		5			1			
Long	8/8/07	41.5212	-87.05065	18	13.0	5		5			1			
Long	8/8/07	41.5222	-87.049744	19	4.0	5	5	5	1	1				1
Long	8/8/07	41.5229	-87.050158	20	19.0	0								
Long	8/8/07	41.5234	-87.049392	21	5.0	5	5	5			3			1
Long	8/8/07	41.5241	-87.049766	22	12.0	5		3			3			
Long	8/8/07	41.5246	-87.048958	23	8.0	5		5			5			1
Long	8/8/07	41.5248	-87.049481	24	15.0	0								
Long	8/8/07	41.5253	-87.04831	25	14.0	5		5			1			
Long	8/8/07	41.5257	-87.047754	26	5.0	5	1	3			5			3
Long	8/8/07	41.5261	-87.04816	27	11.0	5		5			3			
Long	8/8/07	41.526	-87.048662	28	17.0	0								
Long	8/8/07	41.527	-87.048019	29	3.0	5	1	5	3					3
Long	8/8/07	41.5272	-87.048828	30	2.0	3	1	1					1	
Long	8/8/07	41.5267	-87.048608	31	12.0	5		5			1			
Long	8/8/07	41.5266	-87.0496	32	10.0	5		5			3			1
Long	8/8/07	41.526	-87.049319	33	19.0	0								
Long	8/8/07	41.5255	-87.049385	34	17.0	0								
Long	8/8/07	41.5258	-87.050611	35	6.0	5		5			3			1
Long	8/8/07	41.5253	-87.050698	36	6.0	5		3	1					5
Long	8/8/07	41.5247	-87.050644	37	5.0	5		5			1			1
Long	8/8/07	41.5246	-87.049997	38	14.0	0								
Long	8/8/07	41.5234	-87.051083	39	6.0	5	1	5	3					
Long	8/8/07	41.5232	-87.050548	40	14.0	0								

16.2 IDNR VEGETATION PERMIT

APPLICATION FOR AQUATIC VEGETATION CONTROL PERMIT State Form 26727 (R / 11-03) Approved State Board of Accounts 1987 [ ] Whole Lake [X] Multiple Treatment Areas Check type of permit	**FOR OFFICE USE ONLY** License No. Date Issued Lake County	*Return to:* Page **1** of **2** DEPARTMENT OF NATURAL RESOURCES Division of Fish and Wildlife Commercial License Clerk 402 West Washington Street, Room W273 Indianapolis, IN 46204
INSTRUCTIONS: Please print or type information		FEE: $5.00

Applicant's Name: Valparaiso Area Lakes Conservancy District	Lake Assoc. Name: Valparaiso Area Lakes Conservancy District	
Rural Route or Street: 1805 Burlington Beach Road		Phone Number: 219-464-3770
City and State: Valparaiso IN		ZIP Code: 48383
Certified Applicator (if applicable)	Company or Inc. Name	Certification Number
Rural Route or Street		Phone Number
City and State		ZIP Code
Lake (One application per lake): Long Lake	Nearest Town: Valparaiso	County: Porter
Does water flow into a water supply		[ ] Yes [x] No

Please complete one section for *EACH* treatment area. Attach lake map showing treatment area and denote location of any water supply intake.

Treatment Area # 1	LAT/LONG or UTM's	Areas to be determined following spring survey (See AVMP)	
Total acres to be controlled: <12	Proposed shoreline treatment length (ft)		Perpendicular distance from shoreline (ft)
Maximum Depth of Treatment (ft): 12	Expected date(s) of treatment(s)	late May to early June	
Treatment method: [x] Chemical [ ] Physical [ ] Biological Control [ ] Mechanical			

Based on treatment method, describe chemical used, method of physical or mechanical control and disposal area, or the species and stocking rate for biological control. Renovate or 2,4-D herbicide to selectively control Eurasian watermilfoil wherever it occurs

Plant survey method: [x] Rake [x] Visual [ ] Other (specify) Summarized from summer survey

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Eurasian watermilfoil	x	10
Common coontail		35
Bladderwort		10
eel grass		10
Richardsons pondweed		5
American elodea		5
Flatstem pondweed		20
variable pondweed		5

Treatment Area #		LAT/LONG or UTM's			
Total acres to be controlled		Proposed shoreline treatment length (ft)		Perpendicular distance from shoreline (ft)	
Maximum Depth of Treatment (ft)		Expected date(s) of treatment(s)	late April or early May		

Treatment method: [X] Chemical [ ] Physical [ ] Biological Control [ ] Mechanical

Based on treatment method, describe chemical used, method of physical or mechanical control and disposal area, or the species and stocking rate for biological control.

Plant survey method: [ ] Rake [ ] Visual [ ] Other (specify) Summarized from August Sampling

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community

INSTRUCTIONS: Whoever treats the lake fills in "Applicant's Signature" unless they are a professional. If they are a professional company who specializes in lake treatment, they should sign on the "Certified Applicant" line.

Applicant Signature	Date
Certified Applicant's Signature	Date

FOR OFFICE ONLY

[ ] Approved [ ] Disapproved	Fisheries Staff Specialist
[ ] Approved [ ] Disapproved	Environmental Staff Specialist

Mail check or money order in the amount of $5.00 to:

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF FISH AND WILDLIFE
COMMERCIAL LICENSE CLERK
402 WEST WASHINGTON STREET ROOM W273
INDIANAPOLIS, IN 46204

16.3 PUBLIC INPUT QUESTIONNARE

Lake Use Survey Lake name___________________________

Are you a lake property owner? Yes________ No_________

Are you currently a member of your lake association? Yes ___ No___

How many years have you been at the lake?
2 or less
2 – 5 years
5-10 years
Over 10 years

How do you use the lake (mark all that apply)

___Swimming ___Irrigation
___Boating ___Drinking water
___Fishing ___Other _______________________

Do you have aquatic plants at your shoreline in nuisance quantities? Yes ___ No ___

Do you currently participate in a weed control project on the lake? Yes ___ No ___

Does aquatic vegetation interfere with your use or enjoyment of the lake? Yes ___ No___
Does the level of vegetation in the lake affect your property values? Yes ___ No ___

Are you in favor of continuing efforts to control vegetation on the lake? Yes ___ No ___

Are you aware that the LARE funds will only apply to work controlling invasive exotic species, and more work may need to be privately funded? Yes ___ No ___

Mark any of these you think are problems on your lake:

___ Too many boats access the lake
___ Use of jet skis on the lake
___ Too much fishing
___ Fish population problem
___ Dredging needed
___ Overuse by nonresidents
___ Too many aquatic plants
___ Not enough aquatic plants
___ Poor water quality
___ Pier/funneling problem

Please add any comments:

16.4 RESOURCES FOR AQUATIC VEGETATION MANAGEMENT

Books

Aquatic Plant Management in Lakes and Reservoirs, Best Management Practices in Support of Fish and Wildlife Habitat. Aquatic Ecosystem Restoration Foundation. 2005.

Borman, Susan, Korth, Robert, Temte, Jo. Through the Looking Glass. Wisconsin Lakes Partnership. 1997.

Cooke, D.G., Newroth, P.R., Peterson, S.A., Welch, E.B. Lake and Reservoir Restoration. Butterworth Publishers. 1986.

Fassett, Norman C. A Manual of Aquatic Plants. The University of Wisconsin Press. 1985.

Lopinot, A.C. & Winterringer, G.S. Aquatic Plants of Illinois. Department of Registration & Education, Illinois State Museum Division & Department of Conservation, Division of Fisheries. 1977.

Petr, T. Interactions Between Fish and Aquatic Macrophytes in Inland Waters. Food and Agriculture Organization of the United Nations. Rome, 2000.

Societies/Websites

Aquatic Plant Management Society-apms.org
Midwest Aquatic Plant Management Society-mapms.org
North American Lake Management Society-nalms.org
Inidiana Lake Management Society-indianalakes.org
Aquatic Ecosystem Restoration Foundation-www.aquatics.org